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BULLETIN NO. 2—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF ENTOMOLOGY.

PROCEEDINGS

OF THE

SEVENTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

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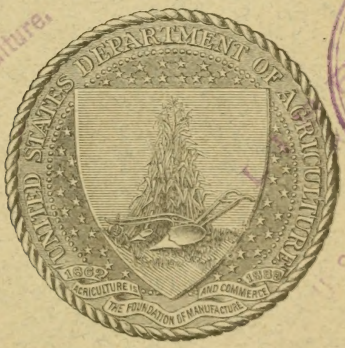

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., October 15, 1895.

SIR: I beg to submit herewith the manuscript of the secretary's report of the proceedings of the seventh annual meeting of the Association of Economic Entomologists, which was held at Springfield, Mass., August 27 and 28, 1895. On account of the fact that the proceedings of this association are invariably of great practical importance, the Department has heretofore been glad to publish the secretary's reports in Insect Life. Since Insect Life has been discontinued, I recommend that the present report be published as Bulletin No. 2 of the new series of bulletins of this division.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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* Published by title only.

SEVENTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, AUGUST 27, 1895.

The association met in room 4, High School building, Springfield, Mass. The following officers and members were present:

President John B. Smith, New Brunswick, N. J.; Vice-President C. H. Fernald, Amherst, Mass.; Secretary C. L. Marlatt, Washington, D. C.; R. A. Cooley, Amherst, Mass.; G. C. Davis, Agricultural College, Mich.; E. H. Forbush, Malden, Mass.; L. O. Howard, Washington, D. C.; A. H. Kirkland, Malden, Mass.; J. A. Lintner, Albany, N. Y.; C. V. Riley, Washington, D. C.; P. H. Rolfs, Lake City, Fla.; F. A. Sirrine, Jamaica, N. Y.; E. B. Southwick, Central Park, New York City; F. M. Webster, Wooster, Ohio; C. M. Weed, Durham, N. H.

There were also in attendance upon the meetings members of other scientific associations and entomologists not members of the association, among the latter Mr. George Dimmock and Mr. Macloskie. The attendance at the different meetings ranged from 20 to 40.

The association was called to order by the president and reports from officers listened to. The amendment to the constitution proposed by Mr. Summers November 13, 1890, but not afterwards taken up, was adopted. It reads as follows:

SEC. 3. The membership shall be confined to workers in economic entomology. All economic entomologists employed by the General or State governments, or by the State experiment stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions, may become members of the association by transmitting the proper credentials to the secretary and by authorizing him to sign their names to this constitution. Other persons engaged in practical work in economic entomology may be elected by a two-thirds vote of the members present at any regular meeting of the association. Members residing out of the United States or Canada shall be designated foreign members. Foreign members shall not be entitled to hold office or to vote.

The following persons were elected active members of the association:

Mr. W. Hague Harrington, Ottawa, Canada; Mr. R. E. Palmer, inspector of fruit pests, British Columbia. Proposed by Mr. Fletcher.

Mr. W. S. Bullard, Bridgeport, Conn.; Mr. John Gifford, State forestry agent, Mays Landing, N. J. Proposed by Mr. Howard.

Mr. E. A. Schwarz, Washington, D. C. Proposed by Mr. Marlatt.

Mr. E. H. Forbush, Malden, Mass.; Mr. A. H. Kirkland, Malden, Mass.; Mr. R. A Cooley, Amherst, Mass. Proposed by Mr. Fernald.

Mr. F. W. Urich, hon. secretary Victoria Institute, Trinidad, and of the Trinidad Field Naturalists' Club.

The annual address of the president followed.

ENTOMOLOGICAL NOTES AND PROBLEMS.

By JOHN B. SMITH, *New Brunswick, N. J.*

One of the chief advantages of being president of this association is that it gives one the opportunity of lecturing his fellow-members. Under the guise of an annual address one has the opportunity of ventilating his views more liberally and at greater length than would be tolerated otherwise, and one has the pleasure of making recommendations and saddling a certain amount of work upon committees to whom may be referred the recommendations contained in the president's address. For your sakes, as well as my own, I will try to be brief, to confine myself to a few points only, and to make as few recommendations as I can get along with.

In the exceedingly useful and interesting presidential address of my immediate predecessor a history of economic entomology and entomologists was given, and it was shown that both had now a recognized standing and influence. This influence, I am happy to say, is constantly on the increase, and is, I think, deserved in most cases, on account of the quality of work accomplished. When entomologists first became abundant, with the establishment of experiment stations, a flood of ill-considered compiled material was printed, which augured badly for the science and for its standing with the intelligent agriculturist. Happily the augury was false, and nowadays bulletins in most instances show the results of original work, or compilations are brief and prepared to meet some present demand. I do not mean to say that republication of well-known facts is always to be condemned; simply that there should be a good reason for it. Thus I have just published a bulletin on the Hessian fly without the least original investigation: but it was needed in New Jersey, because this insect has been on the increase for two years in succession, because the farmers are alarmed and dread further injury, and because I have received numerous letters of inquiry which can hardly be answered without writing a small bulletin for each case. It would have been folly to attempt original investigation on an insect so well known where immediate information was necessary; hence I compiled a very brief bulletin from the researches of those who have had more ample time and opportunities for study, and it serves its purpose and was warranted, I believe.

There is a danger, however, in this method that must be guarded against, and that is expressed in the question, Are the measures recommended applicable in the new locality? We are just awakening to the fact that differences in results obtained by farmers do not always argue ignorance or carelessness, and are realizing that insects or insecticides may vary, either in resisting power or in effectiveness, in different localities, and that we must not hastily conclude that what answers in

California will be equally effective in New Jersey, nor that the conclusions based upon the most careful experiments made in New York can be accepted unquestioned in Idaho. To be more specific, Mr. Slingerland's work on the pear blister-mite is certainly as conscientious a production as can be wished for, and the results obtained by his use of the kerosene emulsion are undoubtedly expressions of actual facts; yet Mr. Aldrich in Idaho finds them utterly useless in his locality, and the insects bear without discomfort applications which Mr. Slingerland found fatal in New York. So Mr. Howard has published, as the result of careful experimentation, that some of the washes found most satisfactory on the Pacific Coast for the destruction of scale insects are of no practical use in the Atlantic States. Mr. Webster has frequently joked me upon my failure to get satisfactory results with the rose-chafer in New Jersey, which he seems to find no difficulty in managing in Ohio. But the methods used by him are simply useless against the species in the Eastern locality.

The point I wish to make is, that there are factors not yet understood by us that should make us cautious in recommending too positively or hastily measures based on results reached in localities different from our own, and on the other hand should make us very chary in condemning work done by a confrère because our results do not agree with his.

The day of testing insecticides is therefore not so nearly over as has been sometimes thought, and we owe it to our constituent, where his results do not agree with our expectations, to test the matter under his conditions before deciding him incompetent; and it does not need the distance between the Atlantic and Pacific to make a difference in condition. Results obtained annually by dozens of farmers in New Jersey seem absolutely unobtainable by most careful experiments made in New York; while I have this season proved, much to my dissatisfaction, that the reverse may be equally true, for I can not secure the results in actual practice with bisulphide of carbon against cabbage maggots which Mr. Slingerland obtained in his experiments. Yet Mr. Slingerland undoubtedly recorded only what he found, and sooner or later the reason for the failure in New Jersey will be discovered.

Each worker must therefore study his own field most carefully, and not the least important subject of study is his constituency, the farmer, for whose benefit he works. I need not tell you, gentlemen, that the old line—

A rogue is a rogue, wherever he may be—

cannot be applied to the farmer. He is different in almost every section and State—even within the limits of a county in some cases—and what will appeal to one type in one locality may be ridiculed as nonsense by another not 20 miles away. There seem to be some characteristics, however, common to the class—among them a marked suspicion as to the good faith of anyone who pretends to do something for him for nothing, and a disinclination to believe that he can learn

anything about his business from the entomologist. The essential problem, then, upon which success depends in a large measure, is how to gain the confidence of the agriculturist and convince him both of your honesty of purpose and of your utter disinclination to offer advice on any but your own specialty. Carelessness in this matter may result as in an instance when I was peddling ballots in a hotly contested election in Brooklyn. A voter asked me for a set of ballots and I foolishly inquired whether he wanted the straight ticket or some pasters. He thought I wanted to know too much and was immediately gobbled up by the other fellow, who gave him an entire handful of ballots and kept his mouth shut. It has surprised me sometimes to find that even in a small State like New Jersey there are localities where the work and object of the Experiment Station is practically unknown, and yet I believe we reach a larger percentage of its farmers by means of our bulletins than in almost any other State in the Union. I have found that the only way to secure attention and respect for the suggestions made is to have personal acquaintances everywhere, to take part in their meetings and even in some cases picnics, to answer freely all sorts of questions, no matter how absurd, and to be interested in the newest and most startling facts in insect life which they have themselves observed again and again and know are true. My latest addition to knowledge of this kind is that the white grub found in manure piles produced the cicada, or harvest fly, and they had been bred so time and time again.

Another problem of some interest is how to deal with newspapers. Now, this does not seem to come exactly within the scope of the entomologist, and I hasten to amend by limiting my remarks as applying to the entomological matter in them. In some cases the most absurd misinformation is given currency, and the farmer, who has no other literature and swears by his paper, accumulates a store of curious facts that are often troublesome to deal with. Electroplate articles are particularly vicious in this direction, because they may appear all over the country; and I have seen in a well-known farm paper, with a department edited by a well-known entomologist, a really good paper by the editor followed without any sort of spacing by an utterly absurd and incorrect note, put in, of course, simply to fill space and without consultation with the editor of the department, who, nevertheless, seemed to be responsible for it. In New Brunswick one of the daily papers has an occasional farm column from which I learn many new facts in economic entomology. I have tried to induce the editor not to put these in without first submitting them to me, and he has promised so often without keeping his promises that I conclude he never reads them himself until they are printed, and the selection is determined entirely by the number of inches covered. I have never been able to learn who writes these articles or how they originate; but it is at least a question whether we can not do something as a body to make the press, and especially the

agricultural press, a distributer of accurate rather than false information. I have no scheme of my own to propose, but is not this a matter worthy of some attention by our association? A curious effect of the wide circulation of some agricultural journals is that sometimes the entomologist of a neighboring or even a far-off State is better known than the home worker, and questions from Illinois, Nebraska, or Ohio may come to New York for solution. So an Associated Press report to the newspapers sometimes brings letters from almost every State in the Union on subjects very much more readily answered by the station entomologists of the respective States, as I am always careful to say when I get communications of that description. Occasionally an erring Jerseyman gets away from me, I know, especially to Washington; but I get my revenge when the authorities in charge of certain parks in that city write to me for methods of dealing with shade-tree insects, apparently in blissful ignorance that anything has been published in their own city especially adapted to their needs.

A subject of considerable interest allied to that just mentioned is, How can we keep track of everything on economic entomology that is published nowadays? The bulletins and reports reach us in due time in most cases, but I am not so sure of even that for myself. I invariably send my bulletins and reports to all the members of this association directly from my own office, and I know that a few are sent to me in the same way, but the practice is by no means universal; and, though I believe some action was taken at a previous meeting, yet I would urge that it be made one of the active obligations of membership in this association that at least all official bulletins and reports be sent to every fellow-member. Even if by this means a duplication occurs, I am never averse to doubling up on a good thing, and, indeed, want two copies whenever I can get them. The Experiment Station Record, published by the United States Department of Agriculture at Washington, keeps us tolerably well informed of what is issued from the experiment stations, and it is easy to get track of a missing bulletin or report; but the numerous articles published in agricultural journals and newspapers are a more serious matter, and I confess my entire inability to keep up with them. I am working absolutely without assistance, except a share in a stenographer and typewriter, who is kept busy constantly in her own special branch, and it is simply impossible for me to find time to look over even all the papers that come to the station, yet I put in on an average twelve hours a day seven days in the week, which is all, in my opinion, that can be reasonably asked. As a consequence, I am constantly learning of notes published here, there, and everywhere long after they have appeared, and sometimes after I have myself published matter upon the subject. I have even been severely criticised by one of my fellow-members, who questioned my results in a farm paper, and have remained in blissful ignorance of my offending until long afterwards. To be sure, it didn't bother me any, but I always

like to know when I am abused, and it usually gives me a pleasurable sensation, which is the reason why I always enjoy Mr. Grote's pleasant productions. It always gives me the opportunity of seeing my name at least once on every page, always associated with some pleasant compliments, and it gratifies me that I am able to afford him the delight which he obviously takes in writing them.

But, to return to the matter in hand, is there not some feasible way of interchanging among the members of this association records of all articles containing original or useful information? Can we not devise some plan by means of which we can keep informed of what is going on without the necessity of wasting time in examining everything and then missing it after all? In view of the unfortunate discontinuance of Insect Life, I would suggest that each member send in every month, or at least quarterly, a list of economic articles published by him. Perhaps Entomological News may be available for the purpose; but at all events I wish to present the matter to the association as one which, in my opinion, merits attention.

There are several unsettled problems concerning publications and the matter to be contained in them; but the discussions heretofore had have not resulted in any agreement, and policies seem rather to be diverging than otherwise. I have decided opinions on the subject, of course, but can not see any prospect of getting satisfactory action at the present time, because in many cases we are not free to decide the matter for ourselves. There are some directors who labor under the delusion that they have the decision in matters of this kind; and, what is worse, they frequently act on that belief.

The matter of cooperation among station workers is still discussed, still declared desirable, and still as far from being put into actual practice as ever before, and comes up before us now on the report of a special committee presented last year. What I have already spoken of concerning the necessity for a special study of all problems for each region or locality may be at first deemed an argument against cooperative work in most directions, and yet it will be only by combining all the results that we will ever get any clear understanding of some of the matters now puzzling us. We can, however, do at least one thing mentioned in the report in the line of uniformity, by agreeing upon some recognized method of conducting experiments, so that results may be comparable. I have seen or have been informed concerning the outfits of many of our stations and have inquired closely concerning the methods of experimentation, and scarcely two are even nearly alike. The elaborate and costly outfits of some stations are in striking contrast with the cheap makeshift apparatus to be found in some others; so that results obtained under such differing conditions are not always to be regarded as of equal authority. I do not mean to suggest that good and reliable work is not or can not be done with even indifferent tools; but the chances of error are decidedly increased. Different

results may be due in some cases to a difference in the breeding or experiment jars, and I have known outdoor results to contradict absolutely those obtained in the laboratory, not only in the failure of a laboratory success, but in the success of a laboratory failure. I think we might easily agree upon some uniform way of testing insecticides and the character of the checks to be employed, particularly for contact poisons, which in my experience are most likely to disappoint us in their action under varying conditions. It would at least be a step in the direction of uniformity in experimentation and therefore toward cooperation, the only one perhaps that is possible at this time—if, indeed, we can agree even so far.

Very recently a practical effort in the way of collating information from all the stations has been made by Mr. Howard, entomologist to the United States Department of Agriculture, in an endeavor to fix more exactly the geographical distribution of a number of the injurious species. What his success has been I do not know, but in some such direction as that cooperation may certainly become a fact without infringing upon individual fields of work.

There is one other point which has not, I believe, been previously discussed at any length—the interchange of specimens of injurious insects and their work. Of course we all try to so describe and figure the pests we study and their injuries that no one can possibly mistake them, and yet, speaking for myself alone, it does happen now and then that the nature of an attack or of an insect sent in is not at once recognized, even if it prove afterwards to be one described at length in another State. Thus I failed to recognize the San Jose scale when first I saw it, nearly two years before it was brought to Dr. Riley's attention. If, however, the members of this association could agree to send to each of their fellow-members, as far as possible, specimens of the injurious insects originally studied by them and their work, this would make matters easier for all, and might prevent blunders in some cases. Of course there are limitations here, and in some cases the material may not be sufficient and a selection must be made among correspondents. As no one can possibly feel hurt if I call attention only to my doings, good and bad, I may say that I have acted up to this idea in sending samples of the work of the sinuate pear borer, for information, to the United States National Museum, the United States Department of Agriculture, the State entomologist of New York, and the Cornell Experiment Station. I will be pleased to send also to anyone else who desires specimens of injury caused. Beetles are yet too scarce to be distributed except to specialists.

Digressions are always allowable in an address of this kind, and I want to make a plea here for a central collection of economic entomology. Either the United States Department of Agriculture, or, perhaps better, the United States National Museum, should receive from entomologists all over the country material for the formation of a biological

collection in which all stages of the insects and their work should be fully illustrated. This would be of enormous advantage to students in a short time, and only think what its extent would be if all of us cooperated honestly and continually for the common benefit!

When I say that Dr. Riley is in charge of the collection at the National Museum, I need add nothing concerning the appreciation with which material of this kind will be received.

As this matter of cooperation came before you in the report presented last year, which I take it you have all considered carefully, I need say nothing more on this head.

In connection with that same report the subject of insect laws or legislation against insect pests will come up, and we have now to guide us the very useful compilation of the laws heretofore enacted, published by the United States Department of Agriculture. I regret to say that public opinion in New Jersey is so indifferent or even hostile to legislation on this subject that no effort was made last winter to pass the bill introduced at the previous session. The matter is not one that I feel called upon to act in myself, except in an advisory capacity, and I have left it where I think it properly belongs—in the hands of the farmers themselves. Until they wake up to the necessities of the case, no law, however good, can be satisfactorily enforced. I suspect that one reason for the lack of enthusiasm in the matter is that almost every man has a secret conviction that he would not be always inclined to live up to the letter of the law himself, and that some critical neighbor might use it against him if he at any time showed himself disposed to insist upon its enforcement against others. Another argument made by one of our apple growers is, "What is the use? I can get perfect apples myself, and the more wormy apples the other fellows have the better the prices I can get for my good ones." This logic is as unanswerable as another, that wormy apples are good enough for cider and apple-jack, to say nothing of vinegar.

Inspection or quarantine laws have been discussed and recommended to prevent distribution of infested stock or the introduction of new pests into new localities, and there may be some practical outcome to this agitation; but until we can arouse a public sentiment strong enough to secure action in all the States little good will be accomplished, and where goods enter a State, as they may do, at dozens of points, any really effective inspection would be an expensive matter.

But here, in the nursery question, we have really a very serious problem, one to which I called attention last year, and which Mr. Howard has mentioned and briefly discussed in a recent paper on scale insects.

It has been suggested that no stock should be purchased except under guaranty of freedom from certain scales or pests; but one of our best nurserymen, to whom I suggested the offering of such a guaranty, refused point-blank to even consider it, on the ground that he could not possibly tell where his stock was going, and if after a year or two

it proved infested, as it might easily become from outside sources, he could not possibly prove its freedom when shipped, nor how infection occurred, especially if a purchaser was inclined to be dishonest and, knowing the source of infestation, destroyed it and chose to take action on the guaranty.

It has been further suggested that a certificate of freedom from certain pests be obtained from the station entomologist. I gave two such last year; but I am very doubtful whether I care to give any more. I examined many nurseries in seeking for the San Jose scale and none that I pronounced clear have since proved infested. But in one case, where I made what I supposed a careful examination in 1894, on a place where only a little stock was raised, of certain special varieties for the immediate neighborhood, and found no scales, I found, to my astonishment, in 1895, a very general infestation which I was not able to trace to any recent introduction. They were probably present on some tree that I did not previously see or from its source had no reason to suspect. To declare a nursery containing many thousands of trees to be free from certain scales is a risky piece of business, unless time be taken to carefully examine each one. Besides, nowadays, few nurseries grow all their stock on their home grounds. Hundreds of thousands of trees are grown for New Jersey nurserymen in New York, Pennsylvania, Georgia, and other Northern, Western, and Southern States, and giving a clean bill of health under such conditions is somewhat unsafe, to say the least, while examining all the heeled-in and moss-packed trees and shrubs is simply an impossible task. Yet something should be done if possible, and if some sort of inspection of nurseries could be arranged for in all States the presence of such pests as are likely to be troublesome would be more promptly discovered, and if remedial measures were not at once applied, a warning sent to other States would serve to acquaint the workers there of a source of danger to be guarded against. Perhaps our scheme of cooperation, when formulated, may include a feasible method of dealing with this problem; but perhaps the best thing we can do at the present time is to impress upon all prospective purchasers the importance of the old legal maxim, Caveat emptor—Purchaser, beware! No stock should be accepted without rigorous inspection, and in case of any unusual, unknown, or abnormal appearance samples should be sent to the experiment stations for advice. Only a very short period of this kind of supervision would impress upon nurserymen the necessity of inspection before shipping, and would make them careful as to the character of the stock sent out.

We have to contend with another factor here, however, which is distinctly important, i. e., the desire on the part of many ill-informed agriculturists to get things cheap. To get a great lot of trees for what they consider a low price they will agree to accept almost anything; and I know positively that nurserymen often get rid of all their otherwise unsalable material by offering it for a mere song—stock which

would be dear at any price, and which must be accepted unquestioned and must be paid for in advance to get the rate. Such stuff, set out to make an orchard, never does well, but often lingers long enough to become a source of serious danger to the neighborhood.

Incidentally this brings up the question of imported pests of recent introduction and limited spread. Is there really no method of meeting these creatures? It is not so long ago that the expenditure of a few hundred dollars would have exterminated the pear midge in the United States; it has by this time destroyed fruit valued at as many thousands. At present the *Agrilus sinuatus*, which is destroying the pear trees in a limited part of New Jersey, can be exterminated at comparatively small cost; if allowed to spread it will soon get beyond control and pear growing will become a burden instead of a source of profit. At present I would guarantee to exterminate it for $5,000, with a law giving me a right of entry only. In ten years ten times that sum will make no impression on it.

In this very State of Massachusetts we have a striking example of a destructive increase of an imported pest—the gypsy moth—and an interesting experiment in the direction of its destruction by the State. There are to be two papers on this subject, I am informed, and there will probably be a discussion on the principles concerned in the matter of dealing with imported pests. But I will take the liberty of offering just a few remarks here, not on the methods employed, but on the general principles involved. Under our scheme of government the individual States jealously reserve to themselves all matters of internal interest, and the Federal authorities are excluded from all save a fairly well-determined class of subjects. But no State seems to owe any duty to its neighbors, and Connecticut can not force Massachusetts to protect it from an invasion by any Massachusetts pest, nor can it claim damages for any resulting injury. Each State is thrown upon its own resources for the protection of its own citizens. Connecticut took no steps to restrain the spread of the pear midge, and New York and New Jersey, though they are sufferers by the neglect, can make no complaint; but these States have in turn left the matter to individual effort, and Pennsylvania and Delaware, when their turn comes, will most likely adopt the same policy of noninterference. There is nothing, in other words, to prevent the spread of this insect over the entire United States except the limitations imposed by nature itself. Just what they are remains to be seen.

Massachusetts owes no duty to other States to protect them from the gypsy moth. She owes a duty to her citizens only, to the extent that her citizens in a legal way themselves determine by their own representatives. If in protecting themselves they protect their neighbors also, they deserve no credit for this result and have no claim for assistance. Yet it is a very grave question whether Massachusetts is not entitled to the assistance of her neighbors or of the General Govern-

ment in her efforts to exterminate this insect. I am offering no opinion as to the possibility of extermination—I have expressed myself both ways and can not find another—but is this not really a matter of national importance, and should not the National Government have certain duties or powers in cases of this kind? Our opinions are almost certain to be tinged by our political preferences; and in my belief that we have a class of subjects in the gypsy moth and pear midge eminently suitable for national control and action I may be prejudiced by the traditions and principles of the party to which, in national matters, I adhere.

Perhaps I have spoken enough of problems and of difficulties, and should mention some of the accomplishments, some problems solved. Unfortunately there are none. Progress there has been in many directions and of the most encouraging kind, but no striking successes, no epoch-making discoveries. We have not yet succeeded, for instance, in dealing more satisfactorily with grasshoppers; but it is decided progress to learn that in a single State several hundred "hopper-dozers" are in use under the direction of the entomologist and that the State has realized the importance and necessity of this kind of work. Our good friend and fellow-member, Dr. Otto Lugger, has certainly succeeded in securing respect for his profession and a reduction of his preachings to practice.

Chinch-bug work continues in a number of States; but we are not much nearer a final decision concerning the actual value of the Sporotrichum as a destructive agent. The chief objection to it seems to be that it requires the intelligent cooperation of the weather to secure the best results, and the weather is notoriously unreliable except in so far that you may count with reasonable certainty that it will not be as you want it.

It is said that nothing is wholly bad, and so I find it possible to see a good feature even in the continued spread and increased injury caused by such imported pests as the elm leaf-beetle. I believe that this creature has done more to arouse public interest in economic entomology than any other single factor for many years past. Our cities are the centers of public interest nowadays and our metropolitan press voices its expression. Insect injury to agricultural products rarely excites more than a passing curiosity, but the depredations of shade-tree insects in streets, parks, on near-by country roads, and on the grounds surrounding country houses attract attention immediately and produce loud and continuous complaints. The press is interested, and through it the public, while those most vitally affected, the owners of fine shade trees, are induced to examine into a question which they would otherwise have considered as of not the least practical interest. It is from this point of view that I welcome the recent great spread and increased injury from this elm leaf-beetle. City and town authorities and village improvement societies have taken up the matter, have inquired into it,

and have even made some more or less successful experiments; and these, if continued, as they must be from the nature of the case, will produce an increased interest in and appreciation of economic entomology. Insecticide machinery and a knowledge of the application of remedial measures against the more common pests will be required of each park department and its employees, and the entomologist will be as important an officer as the landscape gardener. This is an optimistic prediction, but I believe it as I believe in myself, and, as you all know, my conceit is unbounded. For confirmatory evidence I refer you to Mr. Grote.

No new insecticides of value have been introduced within the year, though I have had the pleasure of testing a new "potato-bug exterminator," originating in Wisconsin, in which the potatoes are rolled before they are planted, and are supposed to absorb qualities which render them proof against beetle attack ever after. Perhaps it is because of their extreme depravity that the New Jersey beetles seemed to take especial delight in eating the plants treated with the Wisconsin product, and this brings me to a notice of the fact that the idea of poisoning the plant juice to make it offensive to insects generally seems to appeal strongly to the ordinary mind. We have flourishing in New Jersey, and incorporated under its laws, a "tree-inoculation company" which claims ability to protect trees of all kinds by boring holes in the trunk, near the base, at $1 a hole, filling them up afterwards with a secret compound which is supposed to enter into the circulation and make the wood and foliage so repugnant that insects refuse to eat it. This seems so plausible and so logical that hundreds of owners have authorized the inoculation of their trees. The result is shown in a letter published in the New York Evening Post of August 12; but the writer, while conceding the absolute failure of the inoculation in his case, considers the method as the only true and logical one. It remains for someone to demonstrate the futility of the system in such a way as to be as logical and convincing as the arguments on the other side seem now.

Sometimes observation lends itself to conclusions such as are claimed for the inoculation method, and this was strikingly illustrated by the results of an experiment made by me at Irvington in 1894. To destroy the pear midge I had applied on an orchard also infested with the sinuate pear borer a top-dressing of kainit, at the rate of a ton to the acre. The material was applied late in June and early in July, just when the young borer larvæ were hatching, and, be the cause what it may, neither in the fall of 1894 nor in the spring of 1895 did I succeed in finding any larvæ of the 1894 brood. Of several trees cut down and examined in the spring of 1895 not one contained even a single larva of 1894, although plenty of beetles from the 1893 brood. Now, this may be a mere coincidence, and I am far from even suggesting that the potash applied on the ground had any direct effect on the young larva

in the tree; but might it not possibly exercise an indirect effect? The Keiffer among pears is the least troubled by this borer, because it repairs damage almost as rapidly as it is caused, and quite usually crushes the working larva in its channel, so that it is only rarely that the beetle matures, unless the tree is otherwise weakened. By stimulating growth when the larvæ are young and least able to resist, by means of an excess of readily available fertilizer, it is not impossible that results may be obtained that seem now to be quite out of our reach. That some trees do carry in their sap an excess of certain soluble substances I am convinced from my own observation, and this is not contrary to the teachings of plant physiology; but actual knowledge of the matter is scant, and we have rather an indication of a line in which experiments may prove profitable than results upon which we can base conclusions.

I have noted an increasing tendency of late to attempt the control of insect pests by methods of cultivation or farm practice, and this, in my opinion, is much to be commended. There are periods in the life histories of many insects when they can be easily reached if we only know how, and where resort to some simple bit of field practice may prevent injury. A good example of this is seen in the practice of cutting close to the surface all shoots of blackberry about June 20 to prevent injury from the *Agrilus ruficollis*. All the eggs have been laid at that time, and the new shoots will be exempt, of course, while the larvæ can not develop in those that have been cut down and will die. The whole matter seems so simple now, and yet it is less than two years ago that this was practiced almost simultaneously in New Jersey and Ohio.

Preventing injury from the larvæ of *Melittia ceto* in late squashes by planting summer varieties upon which the eggs are laid and in which the larvæ are afterwards destroyed is another method which has been worth many hundreds of dollars to farmers on Long Island and in New Jersey.

But there is yet much to be done in this direction, and I am convinced that in the future "circumvention" will be practiced in many cases where we now use poison. Farm practice, using this term in its widest sense to include the mechanical treatment of land, selection of fertilizers, date of planting and harvesting, rotation of crops, etc., will in time give us control of many injurious species which at present seem beyond our reach. It must be our aim to ascertain as far as possible the circumstances least favorable to the development and maintenance of the troublesome species, and then our attempt must be to produce just those conditions.

We should, I think, whenever possible, lay great stress upon the importance of destroying crop remnants when they are no longer needed. For instance, cucurbit vines are usually left on the ground after all the crop is off, affording abundant opportunities for the maturing of *Anasa tristis*, the melon lice, and other pests. Removing

them when no longer needed and destroying will save much trouble during the year following. Systematically burning potato vines as soon as the crop is harvested will prevent all danger of injury from the potato-stalk weevil (*Trichobaris trinotata*), and I might cite many other cases were it necessary. We should also set out the advantages of winter work against many kinds of insects in orchard, vineyard, and garden, and the desirability of destroying by fire everything that comes under the head of rubbish. Especially against certain kinds of Hemiptera this sort of work would prove effective, and fire, judiciously used, can be made a valuable friend. So, much of the pruning should be done at this season, where the character of the plant warrants it, and if the cuttings be burnt many ova of insects will be destroyed. But I am telling you old facts which you do not care to hear. My purpose was not to offer them as information, but to urge their more forcible presentation to the farmer, and to indicate that in my opinion the future development of our dealings with insects will be along this line.

I have preached the use of certain fertilizers against certain kinds of insects so long that I really believe in it: the more as results during the present season have again borne out previous conclusions. My pear-midge experiment of a former year was duplicated in a new locality under very different conditions and again proved satisfactory, though not so strikingly successful as the other, owing to local causes. Is not this a matter of some importance in those States where fertilizers are largely used? Could we not gain a very important point if we found positively that the proper selection of a fertilizer, applied at a proper time, prevented or even lessened injury? The subject is quite a new one; and while excellent results have been obtained on the light soils of New Jersey, they may not be equally good on heavier lands, or perhaps must be differently applied. This, too, is one of the cases where field experiments will give more reliable results on the whole than those carried on in the laboratory.

On the whole, I may repeat, we have rather cause for congratulation than otherwise. Our favorite branch of scientific investigation has made continuous and healthy progress; we have firmly established the reason for our existence and have impressed the general public with a dawning of appreciation for the work we are doing. Our session here will, I doubt not, improve our standing, and will at all events be profitable to those taking part.

Mr. Fernald discussed interstate entomological problems with particular reference to the gypsy moth and the attempts to get the work against this insect undertaken by the General Government. He referred also to the difficulties arising from the conflict of interests of different States.

On motion of Mr. Howard, the president and secretary were constituted a programme committee.

Mr. Marlatt read the following paper:

NOTES ON INSECTICIDES.

By C. L. Marlatt, *Washington, D. C.*

KEROSENE AND WATER SPRAY.

At the previous meeting of the association I called attention to the kerosene and water pump designed by Prof. E. S. Goff, of the Wisconsin Experiment Station, and put on the market by the Deming Company. A thorough testing of this apparatus indicated that the percentage of kerosene in the water varied with a number of conditions, such as the comparative fullness of the two tanks, the imperviousness of the two reservoirs to air, and, as afterwards explained by Mr. Goff, the accumulation of oil in the air chamber of the pump during the action of pumping, and its escape therefrom as soon as pressure is released. As a result, it was impossible to know what percentage of oil was coming from the nozzle at any time, and it was concluded that the apparatus was entirely unsuited for careful work, particularly if placed in the hands of comparatively unintelligent laborers. The inventor of this apparatus has since suggested a new combination spray pump to overcome the objections pointed out. This apparatus was described in Garden and Forest, April 10, 1895, and was devised to insure a uniform level for oil and water, and by a different arrangement of the discharge pipes to avoid the accumulation of oil in the air chamber of the pump. I have no doubt that this apparatus of Mr. Goff corrects some at least of the defects in the first apparatus. No opportunity to experiment with it has offered, however, as it is not being manufactured.

Prof. H. E. Weed, of the Mississippi Experiment Station, has, however, described a new modification of the original knapsack kerosene sprayer (Miss. Agric. Exper. Sta., Bull. 32), which he claims to be more satisfactory. This apparatus is being manufactured by the Deming Company and supplants the one originally made by them. It is the apparatus as originally made, with the addition of a check valve to the oil chamber and a graduated arrangement for the oil stopcock, by means of which the oil is indicated on the gauge in percentages ranging from 3¼ to 50. A sample of this apparatus was secured, and, with the assistance of Mr. R. S. Clifton of the division, a series of experiments was made with it, both in spraying the liquid into graduated jars, to determine the actual percentage of oil, and in testing its action on foliage. All the old objections to this apparatus were developed in the experiments. The fullness of the oil and water tanks exerted considerable influence on the percentage of oil, as in the former instance, the best results being obtained when the tanks were both half or more than half filled. After having been reduced by spraying much

below one-half the proportions of kerosene become uncertain. If spraying be suspended, as would naturally result in passing from one tree or plant to another, and the oil stopcock be not closed, there is a very considerable increase in the percentage of oil, apparently from a passage of the oil into the pump and water tank in spite of the presence of the oil valve. It is therefore necessary to immediately shut off the oil after every spraying. Even this will not prevent a variation in the results, because the first minute's spraying, even with this precaution, will show a greater percentage of oil than subsequent pumping will produce. This seems to be due to the accumulation of oil in the air chamber of the pump as a result of the action of the latter, as explained by Mr. Goff. There is also a separation of the oil and the water held in the length of the spray tube.

Even when spraying steadily, without intermission, more or less oil escapes from the oil tank through the pump into the water tank. This is probably by means of the drawing of the oil into the air chamber of the pump owing to the faulty position of the former, as pointed out by Mr. Goff. The series of experiments tried, listed in the accompanying table, indicate the different results obtained by varying the conditions of spraying, all of which would frequently occur in actual practice. They show a range for the two-tenths gauge mark which should produce 20 per cent oil, of from 10 per cent to 23 per cent oil. Spraying continuously, without any stop or shutting off of the oil, will pretty regularly secure 10 per cent oil at the 20 per cent mark on the gauge if the two tanks are half or more than half full. If a stop of a minute be taken and the oil immediately shut off the first spray following has an average of 13 per cent oil. If the oil stopcock be not turned off, but left at the gauge mark, as directed in the bulletin referred to, and which would naturally be done in passing from one tree to another, the percentage of kerosene in the first minute's spray will range from 16 to 23 per cent, and thereafter 10 per cent. Finally, spraying at the different percentages indicated on the gauge, one after another, taking the precaution to operate the machine after each change for a sufficient time to produce the normal mixture, the different amounts of oil produced do not agree with the gauge indications, except the highest—40 and 50 per cent. At the most serviceable percentages—i. e., 10 and 20 per cent—the amount obtained was about one-half that indicated by the gauge.

It was found by repeated experiment that when the index indicated 20 per cent oil, uniform pumping yielded pretty regularly, under favorable conditions of tanks, about 10 per cent strength of oil. This is equivalent to a dilution of ordinary kerosene emulsion with $5\frac{2}{3}$ parts water. A number of plants, including peach, pear, cotton, mulberry, and tomato, were sprayed at this strength. With the exception of the mulberry, no injury to the foliage resulted. With the mulberry, however, a considerable spotting of the leaves with yellow followed in a day or two.

The only experiment against insects was a treatment, twice repeated, against the Euonymus scale. At the time of the application the young scales were emerging in great numbers, and the strength employed was the 0.2 gauge, indicating 20 per cent of kerosene. Samples of oil were taken at intervals during the spraying and indicated an actual strength of oil ranging from 14 to 19 per cent. Examination of the scales a week after spraying indicated that 80 per cent of the young scales and 50 per cent of all scales, young and old, were killed—a result far from satisfactory, and indicating that the kerosene emulsion at much weaker strength of oil is more effective; doubtless because, being of thicker consistency, it is more persistent in its action, whereas the water and oil both evaporate somewhat rapidly. No injury to the bushes resulted even after a second application at the same strength had been made. The second application resulted in the destruction of about the same percentage of the surviving scales as succumbed to the first treatment.

The spray as it comes from the nozzle is milky in color, and when collected in graduated receivers is of the appearance of milk. Although beginning to separate immediately, the separation is not complete in some cases for several hours. There can be no question that when the liquid strikes the plants the oil is as finely divided as it is in the kerosene emulsion. Wherever it collects in drops, however, the oil of course will separate from the water; but, from actual experience in spraying, this does not seem to be a very great source of danger at the 10 per cent strength, which would be considered a pretty strong wash even with kerosene emulsion. In the case of the collection of the liquid in drops the oil which separates is not very considerable, and its influence is modified by the existence of the underlying stratum of water, the slow evaporation of which allows the oil to act on the plant very gradually. The fact that the strength indicated did not injure the tender foliage of the plants is a strong indication that the principle involved is a valuable one and may possibly be made of great service. The objections urged are, therefore, simply in the way of pointing out defects in this particular apparatus, all of which it will probably be possible to correct.

Parallel experiments by application to plants were made with kerosene and whale-oil soap emulsion, the emulsion being used at a strength to give the same percentage of oil obtained with the knapsack pump. The results on the foliage were equally favorable in the latter case. No injury whatever was done. All of the plants sprayed with kerosene and water were treated with the kerosene emulsion with the exception of the mulberry, of which we had only one small tree for experiment. The important points to be noted in correcting this apparatus by the parties who are interested in its manufacture are, first, to insure a uniform percentage of oil for any reasonable condition of tanks as to fullness; second, to make the tank absolutely independent, as well while the pumping is in operation as when the stopcocks are shut off. The remedying of these two defects should prevent the more

serious of the irregularities noted. It is possible that the improved Goff apparatus points out the necessary conditions to overcome the existing defects. It would also be of advantage if by means of some form of index the height of the water and oil could be more readily determined at any time.

EXPERIMENTS WITH PUMP.

The apparatus was charged with kerosene and water, the gauge fixed at $\frac{1}{15}$ ($6\frac{2}{3}$ per cent), and the liquid sprayed into a vessel until the mixture ran whitish.

Tubes 1 and 2 were then filled without intermission. After the lapse of three minutes tubes 3 and 4 were filled without intermission.

The gauge was then fixed at $\frac{2}{10}$ (20 per cent) and the pumping continued until a uniform mixture came from the nozzle, when tubes 5 and 6 were filled without intermission, and after a lapse of three minutes tubes 7 and 8 were filled.

The gauge was left open during the three-minute intervals between experiments 2 and 3, 6 and 7.

More or less oil having entered the water reservoir, the oil was shut off and the pump thoroughly cleaned and refilled.

The gauge was again placed at $\frac{2}{10}$, and after pumping for a sufficient interval the oil was shut off for one minute and promptly stopped. Tubes 9 to 12, inclusive, were filled, with an intermission of one minute between fillings, during which the oil was shut off and pumping suspended.

The pump was then cleaned, refilled, charged at $\frac{2}{10}$, and operated until the normal mixture came from the nozzle. The oil was shut off, pumping suspended for about two minutes, and then tubes 13 to 16, inclusive, filled one after another continuously.

To further test the accuracy of the gauge indications, a series of samples was taken at the different grades indicated. After the change from one mark on the gauge to another the pumping was continued to another vessel for a time sufficient to get the normal mixture at the nozzle.

The following results were obtained:

No.	Per cent of oil indicated by gauge.		Per cent of oil actually obtained.	
	Gauge.	Per cent.	First experiment.	Second experiment.
1	$\frac{1}{15}$	$6\frac{2}{3}$	$1\frac{1}{4}$	.....
2	$\frac{1}{15}$	$6\frac{2}{3}$	$1\frac{1}{4}$	.....
3	$\frac{1}{15}$	$6\frac{2}{3}$	$2\frac{1}{2}$	.....
4	$\frac{1}{15}$	$6\frac{2}{3}$	$1\frac{1}{2}$	.....
5	$\frac{2}{10}$	20	$16\frac{1}{2}$	.....
6	$\frac{2}{10}$	20	10	.....
7	$\frac{2}{10}$	20	23	.....
8	$\frac{2}{10}$	20	18	.....
9	$\frac{2}{10}$	20	$12\frac{1}{4}$	.....
10	$\frac{2}{10}$	20	13	.....
11	$\frac{2}{10}$	20	$12\frac{1}{2}$	.....
12	$\frac{2}{10}$	20	13	.....
13	$\frac{2}{10}$	20	$13\frac{1}{2}$	.....
14	$\frac{2}{10}$	20	10	.....
15	$\frac{2}{10}$	20	10	.....
16	$\frac{2}{10}$	20	10	.....
17	$\frac{5}{10}$	50	60	53
18	$\frac{4}{10}$	40	45	41
19	$\frac{3}{10}$	30	24	23
20	$\frac{2}{10}$	20	$16\frac{2}{3}$	13
21	$\frac{1}{10}$	10	$7\frac{1}{2}$	$6\frac{2}{3}$
22	$\frac{1}{15}$	$6\frac{2}{3}$	5	$5\frac{1}{4}$
23	$\frac{1}{30}$	$3\frac{1}{3}$	2	$\frac{1}{4}$

SOAPS.

The value of fish-oil soaps as insecticides has been particularly emphasized during the past year as a result of experiments conducted by the division against the San Jose scale. A full statement of the outcome of these experiments is given in an article in the last number of Insect Life (vol. VII, pp. 365–374) A full discussion is there given of the effect of the soap on the trees at various strengths, and of the nature and results of its action on the scales. The action of soap washes on insects has also been carefully investigated recently by Targioni-Tozzetti, and Del Guercio. The experiments of these gentlemen have been more particularly in the examination of the physiological action of the soap on insects. The conclusion reached, which seems to be pretty well sustained by the experiments, is that soap has the same action that has been assigned to oil, asphyxiating the insects by closing the stomates, and that the effect is therefore mechanical and not due to any particular caustic action. They made microscopical examinations of insects and found that the soap solutions were effective in forming a delicate film over the external opening of the trachea. They also found the various emulsions experimented with to be effective in proportion to the amount of soap contained in them. Their emulsions, however, were not of the kind we should consider satisfactory. They conclude that simple soap solutions are quite as effective as the more complex emulsions, and seem disposed to abandon emulsions in favor of soap. This is probably going further than the facts warrant, particularly as a careful examination of the writings and experiments of these gentlemen shows that they have not succeeded in making a satisfactory kerosene emulsion according to our standard; but it emphasizes the growing tendency to place soaps among the more valuable insecticides.

In this connection it may be well to call attention to an error which seems to have become widespread, relating to the domestic or home manufacture of soaps. A formula is frequently given nowadays which makes the astounding statement that some 20 pounds of good soap can be obtained by combining 1 pound of lye with 3 pounds of fish oil in 3 gallons of water. This formula had its origin in some experiments conducted by Mr. Alwood in the work of the division on remedies for the hop aphis. Recent careful experimentation in soap manufacture, repeated many times, has shown that there is no possible ground for this statement, and on consultation with three or four prominent soap manufacturers the absurdity of the statement was at once apparent. The fact is that a good hard soap, such as the ordinary whale-oil soap, very little exceeds in weight the combined weights of the oil and lye or grease, and not more than one-fourth or one-third increase in weight can be reasonably counted on. Hence for the proportions given above 4 or 5 pounds of hard soap is the limit. It is true that almost any

quantity of water can be combined with the soap; with a good hard soap, for instance, you can still have a soft soap, a gelatinous mixture, after having added ten or fifteen times the weight of the soap in water. But such a soft soap or soap-and-water mixture can not be used with any hope of good results in following out formulas which call for so many pounds of soap. The result of our experiments was that home-manufactured soap is much more expensive than soap bought in comparatively large quantities from regular makers, at a price, say, of 4 to 6 cents per pound. These manufacturers have the advantage of purchasing ingredients in very large amounts, and the competition is such that the price of the soap to the consumer is but a slight increase over the cost of the ingredients. When the soap is purchased in 1-pound lots, put up in neat druggists' papers, four or five prices are of course asked.

ARSENATE OF LEAD.

This insecticide, introduced by the Gypsy Moth Commission, is so promising in many respects that it is well worth a place in the list of standard mixtures. It has in general been very satisfactory in its effects on insects, and is totally without action on plants at any strength whatever, even when applied almost as a sirup. The chemical nature of this substance has been investigated by Mr. K. P. McElroy, of the Division of Chemistry, and his report, hereto appended, shows in general the nature of the insecticide, and particularly the probable action of an excess of lead acetate, which, at first thought, might not be deemed essential to the insecticide value. Mr. McElroy says:

In accordance with your request, I have looked up the matter of the interaction of lead acetate and sodium arsenate. In the presence of an excess of the former, such as you employ, the reaction proceeds as follows:

$$(Pb(C_2H_2O_2)_2 \cdot 3H_2O)_3 + (Na_2HAsO_4 \cdot 12H_2O)_2 = Pb_3(AsO_4)_2 + (NaC_2H_3O_2)_4 + (HC_2H_3O_2)_2 + (H_2O)_3$$

Expressed otherwise, 1,137 parts by weight of crystallized lead acetate (containing 14.25 per cent of water) react with 804 parts of crystallized sodium arsenate (53.73 per cent of water), both being dissolved in water to form 899 parts of lead arsenate, 328 parts of sodium acetate, 120 parts of acetic acid, and 594 parts of water. The lead acetate, being wholly insoluble in water, separates out, but the other bodies remain dissolved.

Whether lead arsenate suspended in a solution of the above substances plus an excess of lead acetate would prove more advantageous as an insecticide than would the equivalent amounts of lead arsenate and lead acetate used separately I am not prepared to say. That is matter for direct experiment. As a solution of lead acetate dries down to a varnish-like film, it may prove advantageous in a mechanical way in keeping the arsenate on the leaf.

CYANIDE OF POTASSIUM.

The use of this substance in generating hydrocyanic acid gas for the treatment of scale insects has been introduced in the East, and has been particularly experimented with at Charlottesville, Va. Some additional experiments were also made on various scale insects on the Department grounds. The action of the gas was very unsatisfactory,

and analysis of the cyanide subsequently made showed that the particular brand purchased, which should have contained 58 per cent, in point of fact contained only 31.75 per cent. The obvious lesson from this experience is that in the use of a chemical like this, when a definite proportion is required, it will be necessary to have a chemical examination made before there can be any certainty of its accomplishing the desired end.

ARSENITE OF COPPER.

In an article on Paris green in the last number of Insect Life (vol. VII, pp. 408–411), attention was called to a new insecticide, viz, arsenite of copper, prepared under my direction for experimental test. The preparation of this substance occurred to me from a reasonable doubt which I entertained as to whether the Paris green is not really more expensive than is necessary for its use as an insecticide. Paris green is an aceto-arsenite of copper, originally made for use as a pigment, and, having been adopted by entomologists as an insecticide, is now being manufactured for this purpose at the rate of 2,000 tons or more per annum. The cost of this substance is very greatly increased by the addition of acetic acid. The simple arsenite of copper, without the acetic acid, can be had at about half the cost of aceto-arsenite. It has also the very decided advantage of coming in a very fine pulverulent powder, whereas the aceto-arsenite is in the form of rather coarse crystals, which results in its rapid settling in water. In the article referred to no tests with the arsenite of copper were recorded. Since that time, however, a large quantity of arsenite of copper has been obtained, and it has been tested on the foliage of various plants in conjunction with parallel tests with Paris green. The strength used was 1 pound to 100 gallons of water and 1 pound to nearly 200 (192) gallons. The mixtures were made without the use of lime. On the foliage of cotton and pear no injury resulted whatever with either strength or with either mixture. The cotton experimented with was of vigorous growth and the foliage very tender. The pear foliage, however, was mature and hardy. In the case of peach both mixtures resulted in scalding the foliage, the stronger proving very disastrous; but there was practically no difference in the arsenite of copper and the aceto-arsenite. The evidence so far, therefore, goes to indicate that as far as the action on the foliage is concerned the arsenite of copper does not differ materially from ordinary Paris green. An analysis of the arsenite of copper by the Department chemist shows that the arsenic in the arsenite of copper is not soluble to any extent in water, and practically agrees in this respect with aceto-arsenite, but is soluble in weak acetic acid, and would therefore yield to vegetable acids and other natural solvents or to the juices of the digestive apparatus of insects. The percentage of arsenic contained in the arsenite of copper is 49.23, which approximates that usually found in Paris green.

Owing to the lateness of the hour, discussion was deferred until the afternoon session, when it was proposed to present all communications relating to insecticides, following with a general discussion.

AFTERNOON SESSION, AUGUST 27, 1895.

The following paper by Mr. H. E. Weed was read, in his absence, by Mr. Davis:

SOME EXPERIMENTS WITH THE KNAPSACK KEROSENE ATTACHMENT.

By Howard Evarts Weed, *Agricultural College, Miss.*

At the meeting of this association last year Mr. Marlatt reported unfavorably upon a kerosene attachment to the knapsack pump. As my own experiments of last season agreed in the main with those of Mr. Marlatt, steps were taken for the improvement of the attachment so as to obviate (1) any mixture of the two liquids, except in the act of pumping, and (2) guesswork as to the proportions being pumped. As all are doubtless familiar with the improved attachment as now placed upon the market by the Deming Company, and especially as most of the members of this association have personally tried the attachment this season, any description of the apparatus is unnecessary in this connection. I trust that a full discussion of the merits or demerits of the attachment will take place at this meeting, and only regret that I am unable to be present to give the results of my own experiments more informally than can be presented in a paper.

There are two main points to be considered with a new insecticide or an old insecticide applied in a new way: (1) The effect of the insecticide upon insect life, and (2) the effect on the foliage upon which the insects may feed. The mechanical mixture of kerosene with water is designed to do all the work of a kerosene emulsion, and if it accomplishes this matters are greatly simplified and kerosene will be more largely used as an insecticide.

In this paper I had expected to go into detail with each species of insect against which the kerosene attachment has been used, and also present in tabular form a statement giving the results of different strengths of kerosene which different foliages will bear without injury. I find, however, that in the case of the insects against which the kerosene attachment has been used the subject can best be presented in the form of general statements and noting particular species for confirmation, while in the case of the strength of kerosene which foliage will bear without injury the results have been so uniform as to make the contemplated table unnecessary.

In general I find that in the use of the mechanical mixture it takes slightly more kerosene to accomplish the same result as an emulsion,

doubtless owing to the addition of the soap in the latter. The difference, however, is very slight, and as foliage will stand a greater strength of the mechanical mixture than of the emulsion, as explained later, this point can not be an objection to the mechanical mixture, as the cost of the additional kerosene is no more than the cost of the soap. In the literature on this subject a strength of from one-fifteenth to one-tenth has generally been recommended for use against various caterpillars and from one-twentieth to one-fifteenth for plant-lice. I am inclined to think, however, from tests made this season, that the strength of the emulsion as thus generally recommended is hardly enough to accomplish the desired results.

I find that a proportion of two-tenths (two parts kerosene to eight parts water) is needed for thorough work with most caterpillars, although a proportion of one-tenth will kill many young. Thus with *Pieris rapæ* one-tenth will kill about one-half the larvæ, two-tenths being needed for effectual work. In the case of the catalpa sphinx (*Ceratomia catalpæ*) one-tenth killed only a few of the newly hatched larvæ, while two-tenths killed all. Emulsion killed a larger number of these two species than the mechanical mixture, but still a proportion of two-tenths was needed for effective work.

Most species of plant-lice have shown themselves more tenacious of life than I had formerly supposed. While the most of them are killed by an application of one-tenth, two-tenths will do more effective work. The principal species experimented with have been the cabbage aphis (*Aphis brassicæ*) and the grape-vine aphis (*Siphonophora viticola*).

With the use of pyrethrum, mixed with either the kerosene or the water, the mixture has somewhat greater strength, the pyrethrum adding just about as much strength to the mixture as the soap in an emulsion. It is easier to use a greater strength of kerosene, however, than it is to add the pyrethrum.

Kerosene and Bordeaux mixture go well together, but the Bordeaux will not adhere to the foliage as well as when used alone. I have used it especially with the grape-vine aphis, which is common in early summer and can be destroyed at the same time that an application of Bordeaux mixture is made.

The combination of kerosene and Paris green can be made more successfully by the use of the kerosene attachment than when Paris green is added to an emulsion. The Paris green, of course, is mixed with the water in the main tank.

As to the effect of the mechanical mixture on foliage, the results here have been quite a surprise, for I find that the mixture can be applied of a much greater strength than can the emulsion. I have applied it upon all our common plants, and repeated the application at various times to ascertain whether sunlight or other conditions would vary the effect of the application. I find that all plants will stand one-tenth, and so far as I have experimented only the sunflower and tomato are

damaged by two-tenths, and these but slightly. The cabbage is damaged by a prolonged spraying of two-tenths, but is not damaged if only enough at two-tenths is put on to cover well. Practically no tree foliage is damaged by an application of even three-tenths, but beyond this the foliage is injured.

Mr. C. M. Weed read the following paper, exhibiting the apparatus described:

A MODIFICATION OF THE KEROSENE KNAPSACK SPRAYER.

By Clarence M. Weed, *Durham, N. H.*

[Author's abstract.]

The author reported a series of tests of the knapsack sprayer with kerosene attachment, showing that the principal machine now on the market is unreliable in its present form. The chief source of error appears to be due to the continual differences of level in the kerosene and water tanks. To avoid this a kerosene attachment had been made at the New Hampshire Experiment Station, and was exhibited, of the same height as the water reservoir and holding one-tenth as much. A stopcock with a single hole one thirty-second of an inch in diameter connected the kerosene reservoir with the pump. By this arrangement a fairly constant spray having 9 per cent of kerosene in it was obtained. The opinion was expressed that to get successful results we must abandon the idea of having a large range of variation in one combination of reservoirs—i. e., in expecting to get either a 5 per cent or a 30 per cent emulsion by turning a stopcock at a less or greater angle. The author believed that the kerosene sprayer was capable of great improvements along the lines indicated, and thought it too great an advance in methods of insect warfare to be lightly abandoned.

The following communication, by Mr. J. M. Aldrich, was in the form of a letter to the secretary, accompanying a working sample of the apparatus. The apparatus itself and the manner of working it were described by the secretary with the aid of blackboard illustrations. The following is an abstract of the letter:

SPRAYING WITHOUT A PUMP.

By J. M. Aldrich, *Moscow, Idaho.*

[Abstract from letter describing the device.]

The spraying device which was suggested by the author to the association last year (Insect Life, vol. III, p. 114) is again presented to call attention to two changes in the machine from the first idea. First, it is necessary that the stream from the hydrant enter the lance within

rather than beyond the entering point of the insecticide; second, the Nixon nozzle is entirely inapplicable to this form of apparatus, for the reason that it chokes the flow so as to destroy the suction in the insecticide tube. No nozzle has yet been devised free from this objection except a plain deflector tip. The author is aware that a deflector does not give so good a spray as can be obtained in other ways, and hopes yet to overcome this objection.

The spraying device consists of a sort of lance, forked at the base. One fork connects with a hose to a hydrant or water supply under pressure, and the other with a tube leading into the vessel containing the insecticide. Both forks are provided with stopcocks. The suction caused by the passage of the water through the lance induces a flow through the fork and hose leading from the insecticide.

To use the apparatus, attach to an ordinary lawn hose by the large coupling. Turn on the city water, and it will be at once perceived that there is a strong suction through the small or insecticide tube. Put the end of this in a pail of water or kerosene, and, in the case of the apparatus experimented with, 16 per cent of the total discharge comes through it, the stopcock being wide open. By partly turning off the stopcock the proportion of kerosene can be reduced at pleasure, and the percentage may be indicated by graduations on the back part of the stopcock.

For Paris green, make up a pailful at the rate of 1 pound to 25 gallons of water, and when drawn through the machine it will be diluted at the 8 per cent kerosene gauge mark to 1 pound to 150 gallons and thoroughly mixed.

The device was experimented with by the inventor with a water pressure of 75 pounds, which was inferred to be an average for city water.

No claim to novelty for this device was made except in the application. The principle is the same as that in the "jet pump" used for draining out barges, cellars, etc.

If the instrument deserves any name, it is suggested that it be called the Idaho jet sprayer.

Discussion of the foregoing papers followed. Mr. Southwick had canvassed the question of spraying from hydrants in his work in Central Park, New York, but had found it impracticable on account of the insufficient pressure of the water and the small number of hydrants. He said he was devising a steam pump which he hoped would give greater satisfaction than any apparatus hitherto used.

Mr. Davis suggested that any apparatus dependent on a constant water supply, as of hydrants, would be more feasible in the West in connection with irrigation plants.

Mr. Howard remarked that a stream of water produced by a pressure of 75 pounds to the square inch, mentioned by Mr. Aldrich as obtained from his hydrants, was quite sufficient to kill insects, with the exception of scales, without the addition of oil.

Mr. Lintner asked if the oil and water mixture referred to in the various apparatus described in the papers could be properly considered an emulsion.

Mr. Marlatt said that an oil emulsion was merely the breaking up of the oil into minute globules in the emulsifying agent, and that on this basis the water and oil mixture, as long as permanent, was as properly an emulsion as the kerosene and milk mixture. He referred also to the fact that emulsions are often made with solid ingredients, as powdered lime.

Mr. Southwick referred to a nozzle which had lately come under his observation, which effects the mixture of the insecticide element with water at the moment of spraying. He had not yet experimented with it.

Mr. Marlatt said that from the description Mr. Southwick undoubtedly had in mind the Gillmore nozzle (to which Mr. Southwick assented), and said that Mr. Gillmore had been at the Department, and some very careful tests were made with this nozzle with various insecticide agents. The character of the nozzle and the practical objections to its use as at present constructed were pointed out.

Mr. Forbush said he knew of a similar principle at one time employed by a fire apparatus company to mix a fire extinguisher with water at the moment of spraying.

Mr. Smith said it was very encouraging to see such decided interest taken in the manufacture and improvement of machinery for the application of insecticide mixtures. He was of the opinion that the origination of new devices and the work of perfecting old ones or overcoming mechanical difficulties may be safely left to manufacturers, whom he had always found very ready to adopt suggestions in the matter of the betterment of apparatus. In this connection he referred also to the adoption by the Climax Pump Company of an improvement in the kerosene knapsack sprayer suggested by Mr. Goff. His experience with the improved knapsack sprayer, he said, corresponded very closely with that detailed by Mr. Marlatt.

Mr. Marlatt, referring again to the device suggested by Mr. C. M. Weed, pointed out that while the arrangement of the kerosene and oil reservoirs suggested by this author would probably obviate several of the difficulties, still an important objection, arising from the oil escaping into the water chamber during the action of the pump or immediately thereafter, was not corrected by this means, although possibly rectified by the combination suggested by Mr. Goff in a communication in Garden and Forest of April 10, 1895 (vol. VIII, p. 143).

Mr. Smith read the following paper:

"RAUPENLEIM" AND "DENDROLENE."

By JOHN B. SMITH, *New Brunswick, N. J.*

[Author's abstract.*]

"Raupenleim" and "dendrolene" are both crude petroleum products of a butter-like consistency at ordinary temperatures, and becoming only slightly softer at high temperatures. The raupenleim is a German product, very dark in color, with a tarry odor and probably mixed with some tar preparation. The American product is brown in color, almost without odor, and without foreign admixture to disguise its character or give it a specific smell. Raupenleim is largely used in Germany to protect trees from the attacks of certain insects and to prevent their being injured by stock or deer during the winter. The materials were tested comparatively for the purpose of preventing borers from attacking fruit trees, and if possible to prevent their issuance when already under the bark. Both materials can be readily applied with a paddle or trowel and distributed by means of a stiff brush so as to make a tolerably even coating. Experiments showed that it did not injure even young shoots where applied to the bark only; but where buds or growing tissue were covered it killed the buds and shoots by choking the stomata. A young tree set out in 1894 was covered from the surface of the ground to the buds without detracting from its vigor during the balance of the season. It was applied upon an orchard of pear trees infested by the sinuate pear borer and both materials prevented oviposition. The raupenleim absolutely prevented the issuance of all the beetles maturing under the bark. The dendrolene did the same where thoroughly applied. The raupenleim has a tendency to harden on the surface. This is a good thing where it is intended to prevent beetles from issuing from the trees, but a bad thing where it is intended to prevent insects from crawling up the trunk. The dendrolene becomes very soft at high temperatures without running. This prevents insects from crossing it; but where it is applied thin it does not always form a barrier to insects emerging through the bark. Its application is recommended as against the fruit bark-beetle (*Scolytus rugulosus*), which can not emerge through it when already in the tree, and can not enter the bark protected by a coating. It was also tested against peach borers, and both materials proved effective.

It was stated by the grower conducting the experiments that the dendrolene killed the borers that were in the tree when it was applied, while the raupenleim did not. This fact may have been accidental and is not to be expected under ordinary conditions. The material is recommended for application to fruit trees to prevent attacks of round

* The entire paper is published as Bulletin No. 111 of the New Jersey Agricultural College Experiment Station, October, 1895.

and flat headed borers, and also wherever it is desirable to prevent insects from ascending or descending the trunk. A broad band, put on thickly, is recommended against the codling moth, and in cities against the white-marked tussock moth and the bag worm. It is suggested that applied on trunks on which insects like the pear psylla hibernate it will destroy these insects by preventing their coming out in the spring.

The cost of the raupenleim, free on board, in New York City is, for 25 pounds, $3.75; 50 pounds, $6.75; 100 pounds, $12.75; barrel, from 250 to 275 pounds net, about $25. Dendrolene is supplied free on board at 6 cents a pound in New Brunswick, N. J., in lots of 25 to 50 pounds, and at 5½ cents in lots of 100 pounds and over. The material can be washed from the trunks of the trees if desired by a strong potash mixture, say 1 pound of potash in a gallon of water. As the substance is a mineral product, it does not become rancid.

In answer to a question as to the composition of the lime, Dr. Smith stated that it was chiefly, if not entirely, crude mineral oil.

Mr. Southwick read extracts from a letter from agents for an imported insect lime, which were very extravagant in statement.

Mr. Fernald said he had experimented with the lime against the spring canker-worm, in conjunction with other experiments with printer's ink, the latter applied on paper bands, and banding the trees also with cotton, two or more bands being placed on the same trunk. Very few worms passed over the cotton bands, considerable numbers over the ink bands, and a few over the lime. The larvæ effected their passage over the latter chiefly on cool mornings, which indicates that very diverse effects may be expected in different climates. He thought that of the three substances experimented with the imported or raupenleim gave the best results.

Mr. Howard asked what period of the year was included in the five months during which the lime was on certain trees.

Mr. Smith replied that they were the five months immediately preceding the middle of July.

Mr. Lintner suggested that the lime be so thinned down that it could be sprayed, to facilitate application.

Mr. Smith stated that this thinning would be especially desirable for work against scale insects, but that even when considerably thinned it could not be sprayed through an ordinary spraying nozzle.

Mr. Forbush said he had not his notes with him and therefore could not give in detail his experience with lime, which had been very extensive. He had used the raupenleim and an American material, Menzel's brand. He had found considerable difference in imported material obtained in different years. Sometimes it had proved very unsatisfactory, and he had discontinued its use for other methods which he deemed more advisable

for his work. He said that some insects can cross the lime, but when it is warm, and especially on sunny days, it is a nearly perfect barrier. On cool days, and particularly in stormy, rainy weather, insects can pass it with comparative ease. On smooth bark it will run somewhat, and will also crack or break, especially on rough-barked trees. German authors, he stated, claim that no injury results to the trees from its application, and his own experience was confirmatory of this. The only injury he had noticed came from the scraping prior to the application of the lime, or injury from the lime as a result of such scraping of the bark. On dusty streets the lime soon crusts over and may be crossed by insects, and pine needles adhering to it produce a similar result. It is claimed by some that limed trees are not frequented by birds, but this idea was not confirmed by his own experience. He had used various machines and various devices had been constructed by the commission for the application of the lime. The necessity in cities or public parks of applying the lime at considerable heights on the trunks to prevent contact with it on the part of passers-by rendered many machines for its application impracticable for his purpose, and he had been compelled to employ chiefly paddles and trowels. European machines were found to be crude and somewhat unsatisfactory. He said that in Europe the lime was employed also as a coating for egg masses to prevent the escape of the larvæ. The objection to this was that such egg masses were very apt to be broken open by squirrels and the larvæ thus enabled to escape at the proper time. He thought lime would be of value, particularly against the cankerworm. He had found in certain instances that after lime had been exposed on trees during summer and winter the following spring it was still of a consistency to be of service.

Mr. Smith said that the dendrolene referred to in his paper is entirely without odor, whereas the European lime smells very strongly of tar. He was of the opinion that this odor was given to the European product to conceal its true composition.

Mr. Davis had tried wool bands with parallel experiments with raupenleim against canker-worms, and found the latter successful in every instance; but this could not be said of the wool bands. He had found lime impracticable against cutworms, many of them crawling over it in the cool of the evening; and it had not proved entirely satisfactory against the peach borer, as the borers frequently emerged in spite of the coating of lime.

Mr. Smith said that this would be very probably the case if the application were made to the peach after the larvæ were in the tree, but that the application would be more successful if used to deter the moth from ovipositing.

Mr. Southwick said that in his experience he had found the tussock moth larvæ so numerous that they had been able to crawl over the lime on account of mere numbers.

Mr. Smith said this would not occur in the case of young larvæ.

Mr. Forbush said larvæ would bridge over any band when very numerous, and that such a result could only be prevented by visiting the bands at frequent intervals and collecting the larvæ accumulated beneath.

Mr. Smith said that the American product referred to in his paper was less affected by extremes of temperature than the European lime. He was convinced that in insect lime we have a valuable means of defense against many insects, but that there is room for considerable improvement at present.

Mr. Forbush said that while he had discontinued its use in the work against the gypsy moth, he believed that there were great possibilities in the proper use of insect lime.

Mr. Fernald, referring to the Russian lime, said that all the material probably came originally from Germany.

Mr. Smith stated that the constituent elements of the lime very possibly came from the oil regions of Russia.

Mr. Marlatt said the Department of Agriculture had received samples of this raupenleim and called attention to the very strong similarity between this substance and ordinary axle grease, both in odor and physical qualities, and suggested that the composition of the lime was probably very similar to that of axle grease. He said that in applications to trees, as against scale insects and wherever applications were more generally made than by mere banding, the after effect on the tree would probably be disastrous, although it might not develop for some months. Experiments with other oils on trees gave a strong probability in this direction.

Mr. Smith said the insect limes would very probably turn out to be material similar to axle grease. The dendrolene referred to by him was a Standard Oil Company's product, and would very likely appear under different names as coming from different houses, although all would obtain their supply from the Standard Oil Company. As applied to old bark, which had no vital function, subsequent injury need not be feared.

Mr. Howard referred to the press reports of the loss by a Kentucky orchardist of a thousand valuable peach trees from the application of linseed oil, with other ingredients, as a preventive to the borer. The recommendation which led to the application was charged to the Department of Agriculture, this charge proving, however, by the man's own admission, to be unfounded.

Mr. Davis remarked that a similar remedy had been recommended by the United States pomologist to the fruit growers of Michigan.

Mr. Smith called attention to the necessity, in reporting results, of giving adequate explanations, instancing the danger of confusion in the use of the term "emulsion" arising from the different kerosene emulsion formulas used as a case in point.

Mr. Forbush gave further results obtained by the Massachusetts Gypsy Moth Commission in the use of lime against the gypsy moth and against the tent caterpillar, all indicating the value of lime. He also described the method of clearing out underbrush as a means of starving out the larvæ.

Mr. Howard said the starving-out plan was the one principally relied on in the work against the nun moth in Austria. Trees of considerable size were banded with the insect lime to prevent the ascent of the larvæ, and all low-growing vegetation was then absolutely destroyed, and the larvæ perished for want of food. He further said that there are certain species of plant-lice which descend the trunks of trees in autumn and ascend again in spring, against which bands of lime could be used to advantage. This would be particularly the case with the species common upon the tulip tree.

Mr. Lintner, referring to the difficulty of preparing a good emulsion, suggested the advisability of someone's undertaking the preparation of the emulsion as a merchantable article, to facilitate its use by the general public, who were not sufficiently skilled or equipped to undertake its home manufacture.

Mr. Smith said that some patented insecticides very closely imitated the kerosene emulsion, but were more expensive than their cost of manufacture warranted; but he agreed with Dr. Lintner as to the desirability of having the standard emulsion on sale.

Mr. Howard said that where an appropriation was available the superintendent of parks might make the emulsion and distribute it free of charge, as had been done in New Haven.

Mr. Southwick read a paper entitled "A City Entomologist and Insecticides." It related to the experiences, amusing and otherwise, which had happened to the author during his term of office as Entomologist of New York City, and was not designed for publication.

Mr. Davis presented a paper entitled "Insects of the Season in Michigan."*

The paper was discussed briefly by the following members:

Mr. Smith, discussing the work of Scolytus, stated that they normally attack weakened or unhealthy trees, and that a vigorous tree would require very considerable work by Scolytus to seriously injure it.

Mr. Lintner said he understood from Mr. Davis that the trees were thus diseased and unhealthy.

Mr. Davis replied that some of the trees were thrifty and others lacked vigor.

Mr. Rolfs referred to the great numbers of scolytids which followed the disastrous frost of last winter in Florida, causing great alarm among fruit growers. He said, however, that the trees attacked were such as were greatly injured by the frost and would probably have died any

* This paper was published in part in the Allegan Gazette during July.

way from the effects of the latter, and that the beetles were always present, though rarely injuriously abundant.

Mr. Howard said that it is well known that in the absence of sickly trees Scolytus will attack healthy and vigorous trees, and that the present large numbers of Scolytus are therefore a constant menace.

Mr. Smith said he had been informed by Mr. Schwarz that the beetles will enter healthy, vigorous trees, but are unable to successfully propagate in them.

Mr. Lintner said that Professor Peck had found scolytids attacking perfectly healthy spruces.

Mr. Smith, referring to the climbing cutworms, said that he had been frequently called on to determine for correspondents moths described as having been bred from climbing larvæ. He had received several such from Mr. Slingerland. He questioned if they did not adapt themselves to differing conditions, sometimes assuming the climbing habit, while perhaps normally working on the ground.

Mr. Howard reported that the species *Mamestra subjuncta* and *Agrotis scandens* had been repeatedly sent in this year as climbing cutworms.

Mr. Sirrine asked if all cutworms did not climb as young larvæ, giving his experience with cabbage cutworms as sustaining that view.

Mr. Smith said that this is the habit of *Carneades messoria* on onions. In this connection he urged the value of personal observation to impress one with the true significance and importance of the working habits of insects. In illustration of this he referred to his having recently witnessed a grasshopper invasion in the West, which had brought to him a realization of the possibilities of this insect to which before he had been a stranger. He said also that the Hessian fly, commented on by Mr. Davis, had proved very much more numerous in New Jersey this year than in years recently past.

Mr. Lintner said this fly was also very abundant in western New York.

Mr. Howard said this is distinctively a Hessian fly year, and that the division of entomology had recently found it necessary to issue a circular to facilitate answering the numerous inquiries received on the subject.

The following paper, by Mr. Chittenden, was read by Mr. Sirrine:

HERBIVOROUS HABITS OF CERTAIN DERMESTIDÆ.

By F. H. Chittenden, *Washington, D. C.*

[Author's abstract.]

The Dermestidæ, as is well known, feed chiefly upon dried animal substances. Certain species, however, are reported to have injured vegetable material, and a few recorded instances of damage of this character were cited. Until very recently the various species of household Dermestidæ had not been suspected of actually breeding in other

than animal substances, but the experiments of the writer indicate that they subsist also on a vegetal diet.

The larva of *Attagenus piceus*, or black carpet beetle, was received in cereals from various sources, and was finally brought to the attention of the writer in such manner as to lead to a suspicion that it might feed, at least occasionally, on vegetable substances. Adult insects were confined in a jar of flour and meal, and their progeny were found to thrive upon this material. This species was also found to breed in timothy seed, and incidental mention was made of serious injury to bolting cloth by it in a mill at Georgetown, D. C. A brief review of the history of this insect in America, where it has been known since about 1806, was given, and instances of its reported occurrences in granaries cited.

Trogoderma tarsale Melsh., a common museum pest, was found to infest flaxseed, castor beans, and cayenne pepper that had been on exhibition in the museum of the United States Department of Agriculture, the larva having been reared from the egg deposited in these substances and the adults having bred from other larvæ feeding on them.

An unknown and evidently recently imported species of Trogoderma was stated to be living in flaxseed, castor beans, and silkworm cocoons with the above-mentioned species, and in red-clover seed. This species is believed to have been introduced at Washington in the silkworm cocoons. It has been taken in New Mexico and will probably be found to have established itself elsewhere in the United States.

Anthrenus verbasci Linn., our most abundant insect cabinet pest, was reported as occurring in "middlings" and spoiled flour, and the fact mentioned that at the time of writing larvæ placed in flour were feeding upon it, from which it was judged that they would in due time reach the adult condition.

In conclusion, it was stated that in the case of the Attagenus and Anthrenus these insects were probably first attracted to granaries by the presence of weevils and other grain insects, and that the granivorous habit is consequently an acquired one. The presence of Trogoderma in oil seeds and red pepper, however, admits of no other explanation than that of the absence of animal food, and shows a wonderful adaptability to unnatural environment.

Mr. Howard said that the "buffalo moth" does not occur in Washington, its place being taken by *Attagenus piceus*. He asked for the experience of others as to the former insect to determine its southern extension. *A. piceus*, he said, is not so troublesome as the "buffalo moth" but is yet a serious pest. In answer to a query from Mr. Davis he gave a brief description of the larvæ of the two species.

Mr. Lintner, referring to the popular designation of the insect as the "buffalo moth," said that he had often urged the discontinuance of the use of this misnomer and thought an effort should be made to secure

popular acceptance of a more appropriate common name for this species. He thought it not so strange that Dermestidæ feed on vegetable material, since many species having an altogether animal-feeding habit in the larval state are vegetable feeders as adults, instancing the feeding of larvæ of various species on woolens and other animal products, the adults of which feed on pollen.

Mr. Fernald discussed the use against these insects of inflammable and explosive insecticides in connection with its bearing on insurance policies and was inclined on this latter account not to recommend them. He gave the method of controlling the carpet beetle followed with success by his wife, as follows: (1) Before bringing flowers into the house thoroughly shake them to dislodge the beetles. (2) Regularly collect and destroy the beetles which emerge and gather on the windows of the house during the months of March and April. (3) Carefully treat the carpets on the upper floors of the house, as the beetles commonly enter through the upper windows, and these carpets act as traps, getting the first and the bulk of the invasion.

Mr. Davis said his wife had been unsuccessful in the use of similar remedies.

Mr. Rolfs said that the work of the carpet beetle was much worse in the South than in the North, but he did not know the species. He used carbon bisulphide or cyanide gas, preferring the latter. If used with caution he thought neither of these substances dangerous, and their use was especially desirable in connection with herbariums.

Mr. Lintner said that he ordinarily recommended kerosene, which he thought more suitable than gasoline. Before laying new carpets all the grooves should be carefully filled with cement or plaster, and the carpets should be left loose at the borders to facilitate frequent investigation. The use of tarred paper was also advisable. He had found the following trap method valuable: Remove all woolens from rooms or closets and scatter about them bits of red flannel, which is a very attractive bait for the Anthrenus. The beetles thus attracted are afterwards collected and destroyed. Referring to Mr. Fernald's statement regarding the method of entrance of the beetles from flowers out of doors, he said that this is a common experience and that they commonly enter houses through the upper windows and appear first in the carpets of the upper rooms.

Mr. Fernald discussed the subject of the relation of color in woolens or carpets to infestation by the "buffalo moth," and said that it had been carefully investigated by his former assistant, Mr. Lounsbury, as to the attractiveness both of particular colors and different dyes to the beetles. The information was sought from various sources, including factories for the manufacture of carpets and rugs. The conclusion arrived at was that color is not an important factor—at least the beetles do not confine their attacks to particular colors, though showing a preference for the greens. He thought it more likely that the

preference exhibited by the beetles in certain cases was due rather to the mordant employed.

Mr. Howard said that the best remedy, and the one which he now always advised, was to abandon the use of carpets altogether.

Mr. Smith had used the method suggested by Mr. Davis and had also employed gasoline. He had not found anything in insurance policies against the use of this or like substances in small quantities, but he was always careful to urge the greatest caution in the use of inflammable substances. He gave, by request, certain experiences which he had had with the use of bisulphide of carbon in the National Museum, a rather serious explosion having in one instance occurred from the ignition of this substance by the heat from a steam radiator, while there was another equally startling case of the ignition of the substance in a large box, resulting from a spark having been struck off from a nail in fastening down the lid of the box in which the bisulphide had been placed. In the latter case the box exploded, and the negro laborer was either thrown or had leaped a distance of some feet under the excitement of the moment.

Mr. Howard asked Mr. Taylor, a visitor present, who is engaged in the manufacture of bisulphide of carbon, if he knew of any cases of accident from the use of this substance.

Mr. Taylor replied that he knew of but one case of serious results, and that was where an explosion had resulted from a stroke of lightning. He was inclined to think that with ordinary precautions the danger was trifling. He said that the substance will ignite at 220° F.

Mr. Smith said that the radiator referred to by him was not nearly so hot as that.

On motion, the following nominating committee was appointed: Messrs. Lintner, Rolfs, and Davis.

WEDNESDAY MORNING, AUGUST 28, 1895.

The auditing committee appointed at a previous meeting, consisting of Messrs. Southwick and Lintner, reported that they had examined the accounts of the secretary and found them to be correct. They indicated total receipts from dues of $30, and total expenditures for postage and printing for the years 1894 and 1895 of $22.67, leaving a cash balance of $7.33.

The report was adopted and the committee discharged.

The three papers following, relating to the same subject, by Messrs. Howard, Marlatt, and Lintner, were then read, the discussion being postponed until the end.

SOME SHADE-TREE INSECTS OF SPRINGFIELD AND OTHER NEW ENGLAND CITIES.

By L. O. Howard, *Washington, D. C.*

THE ELM LEAF-BEETLE.

It is not worth while to speak of any shade-tree insects in Springfield at the present time other than the elm leaf-beetle, *Galerucella luteola* (*xanthomelæna*), and the woolly maple leaf-louse (*Pseudococcus aceris*), so I shall confine my remarks in the main to these. In July I took a rather rambling trip through Connecticut and Massachusetts, largely with a view to the settlement of the northern boundary in New England of certain injurious insects, a matter which I had found it difficult to settle by correspondence, and the elm leaf-beetle soon became the most interesting feature of the little investigation.

It is now a number of years since this insect in its slow progress moved up the Hudson River to Albany, but it seems to be very recently that it has begun a similar march up the Connecticut River in New England, although for many years it has been known on both sides of Long Island Sound. Even New Haven, as far south as that city lies, has known this insect for but a few years, and at Hartford, although this season the trees are brown and bare, little work was done by the beetle last year, and in 1893 Hartfordites were unfamiliar with it.

In Massachusetts there has never been a verified published statement of its occurrence before the present season.

Coming westward from Boston on the Boston and Albany Road in the third week of July, and stopping off at many points in search of the insects I had listed, I first found the elm leaf-beetle here in Springfield. At that time only here and there a tree was damaged, and in no case was the foliage nearly all eaten. Realizing that the insect had probably spread still farther up the valley, I traced it northward. At Holyoke and Northampton I found it about as bad as at Springfield. At Amherst I found it upon nearly all of the trees examined, although no especial damage had been done; and at Millers Falls, only 12 miles south of the State line, it was found rather abundantly upon a few trees.

I had not time to pursue the insect farther, but a few specimens received since indicate that it has spread in small numbers some 50 miles farther up the valley.

There seems to be no reason to suppose that the elm leaf-beetle will not multiply and become the same grievous enemy to elm shade trees in Springfield, Northampton, and Amherst in another year or two that it has been this year in Hartford and New Haven and for many years in other cities in Atlantic States south to North Carolina. Whether it will spread to any considerable extent east and west of the Connecticut River Valley in Massachusetts remains to be seen. It may do so, but

I am inclined to think that in towns of higher elevation and which lie decidedly outside of the upper austral life zone it will not assume the serious aspect that it takes on within this zone.

I have spoken only of its occurrence in cities, partly because its importance in cities is so very great, and also because it practically does not occur outside of cities or towns where elms are planted in some number and rather close proximity. In Washington, where the insect has been known for more than forty years, it does not occur upon elms growing along neighboring country roads or even in immediate suburbs. I have noticed the same thing in New England. The plain inference is that the insect does not spread from town to town by using country trees as stepping-stones. The great means of transport here must be the railroads. The beetles developing on trees near railway stations, searching in late summer for hibernating places, can certainly find no more convenient places than freight or box cars. It is probably mainly in this way that it has spread up this valley, and in this way it has probably been carried many times into regions where the climatic conditions are such that it has not succeeded in perpetuating itself.

That the elm leaf-beetle should be a more serious insect plague in New England than it is farther south seems rather a strange fact, aside from the somewhat greater popularity of the elm as a shade tree North than South.

It is, however, a much more serious enemy here, and this is due to the comparative shortness of the season. I have seen handsome old trees in Stratford, Conn., absolutely killed after three years' consecutive and complete defoliation. The recuperative powers of the more southern elms lie in their ability to throw out a second and even a third crop of leaves, with rains coming at the right time. It results from this fact that trees defoliated forty years in succession are still apparently healthy, although they have not made much growth—almost none at all. With rains at the right time, in late July and early August, and abundant rains they must be, Connecticut trees will put out a second crop of leaves and will recover to a considerable extent. With a drought through August, however, extending either side a little into July and September, the trees remain without leaf surface the whole year, and are practically asphyxiated in a couple of seasons. The Stratford elms were killed in this way, and if we are to believe the newspaper accounts, a number of trees on the Princeton College campus have died this year from the same cause.

The unsightly appearance of the defoliated trees, therefore, the nonfulfillment of their function as shade makers, and their possible, if not probable, early death make the destruction of the elm leaf-beetle in Springfield and other Connecticut River Valley towns a matter of very great importance.

Of all the remedies which have been proposed none is so satisfactory as thorough and careful spraying with some arsenical mixture. No

other remedy is worth a moment's consideration except the destruction of the larvæ on the tree trunks or at the surface of the ground after their work is done. This latter remedy, however, can never be made complete; it is only palliative at best, since many must escape. The best way to practice it is to scrape the trunks rather smooth, since otherwise many larvæ will never reach the ground, but will transform under every loose bark scale, and then to make some inclosure around the base of the tree in which the larvæ will accumulate and in which they can be killed conveniently, either with hot water or strong kerosene emulsion. Even then great numbers of larvæ will drop to the ground from overhanging terminal branches, and some treatment must be given the whole ground surface covered by the tree if the operation is to be even approximately thorough.

Where early spraying is neglected, as it was this year here and in New Haven, work of the kind just outlined should be conscientiously carried out, as, indeed, it was in both of the cities mentioned.* The spraying, however, is far more important, both on account of its greater completeness and for the obvious reason that it locks the barn door before the horse, if not stolen, is at least borrowed for the year.

This remedial advice is so far trite to the members of this association, but they may be interested to know that by means of three early sprayings the elms on the grounds of the Department of Agriculture, at Washington, have been kept in prime condition this season. The details of this work will be given by Mr. Marlatt in a later paper.

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* Remedial work was begun in New Haven July 15. At this time thousands of trees were brown and the larvæ had begun to descend to the earth. The subcommittee of the board of public works having this matter in charge authorized Mr. T. B. Kelly, the superintendent of parks, to go ahead and do what he thought best at an expense not to exceed $1,500. Mr. Kelly, fortunately, had posted himself thoroughly on the elm leaf-beetle, and was consequently able to begin work in the most intelligent way. He had kerosene emulsion made on a very large scale, and immediately had the loose bark on the trees scraped off and the emulsion applied not only to the larvæ descending the trunk but also to those which had transformed at the base of the trunk, and had the ground saturated under the entire limb spread. Mr. Kelly used the standard emulsion diluted with five parts of water, and this he found to be perfectly successful. In addition to this treatment of the shade trees, all of the newspapers were notified that citizens having affected elm trees on their grounds could obtain the standard emulsion upon application to Mr. Kelly. The citizens almost without exception took advantage of this offer and large quantities of the emulsion were given out. In the course of a month over 14,000 trees, nearly all of very large size, had been treated by the superintendent of parks. In addition to the use of the emulsion many citizens adopted a cheap, simple, and ingenious band, which consisted of hay wrapped around the tree and covered with a cloth held in place with a pin. Every morning the cloth was removed and the hay burned, new hay being substituted. In this way many thousands of larvæ were caught and killed. Other plans were used by citizens, such as bands of sticky fly paper; but these are not worth mention. As there are probably 30,000 elms in the city of New Haven, the work could not have been complete, but a strong popular sentiment has been aroused, and appropriations will probably be made in time for an active spring campaign.

The serious and immediate question with affected New England cities is how to bring about general and prompt spraying. In most cities there are no appropriations for the specific care of shade trees. In general they are under the control of the street and sewer department or board of public works, and only very small sums can be diverted to their care. It will be important for the board of aldermen in each Connecticut River Valley city this winter to appropriate from $1,500 to $2,000, all of which may be used for the destruction of shade-tree insects, and particularly the elm leaf-beetle. This appropriation should be made available well before spring to enable the supervisor of streets or the city forester (if there be such an officer) to make his plans and get his apparatus ready. This having been done, I firmly believe that it will prove economical in the end for each town to have a steam spraying apparatus rigged up for this specific purpose. A small portable engine with abundant throwing and tank capacity can be put together, according to estimates submitted to my office by manufacturers last spring, for from $300 to $400. An apparatus of this sort, throwing from three or four nozzles a perfect spray at the rate of several gallons per second, would alone cover the threatened trees in a city the size of Springfield in a few days.

Without such an apparatus the city steam fire engines may be utilized, or the construction of several tank carts with strong hand force pumps will be necessary, full details concerning which can be had from the experiment stations at Amherst and New Haven.

I am perfectly aware of the probable difficulty in securing such an appropriation from the average city government; but a determined and widespread popular sentiment frequently expressed will bring it. I almost wish that there were no alternative, so that the work could be done properly and thoroughly and by the proper authorities; but truth compels me to state that there is a fairly good alternative in private enterprise. Out in California for some years back individuals have conducted orchard spraying and fumigating operations commercially on a basis of so much per orchard or so much per tree. A pioneer in this business in the East appeared last year or the year before in the person of Mr. W. S. Bullard, of Bridgeport, Conn., who I am sure will not object if I give him some prominence in this connection. Mr. Bullard is a gentleman whose regular business, that of a contractor for roofing and paving, ordinarily leaves him some leisure in June and July, and this leisure he has utilized in an enlightened way by constructing several good tank-cart spraying apparatuses and contracting to keep the elms on the places of many wealthy Bridgeport citizens in good condition through the summer at a certain rate per tree. Mr. Bullard is not making a fortune at this business, but he keeps his men employed at an otherwise dull time, and he does his work well. The result is that owing to his efforts I saw more green elms in Bridgeport the third week in July than in any other badly infested city which I visited.

Barring appropriations from city governments, then, here is a chance for a private enterprise in which any intelligent man can engage.

This, however, is only a fair substitute for the general work under the city forester. Perhaps I might more truthfully have said that it is a rather poor substitute; for probably only a comparatively small proportion of the citizens of a town will feel like going to the expense of having the work done in this way, and unless all trees in a neighborhood are treated the work will have to be done over and over again year after year.

One word more must be said about the city appropriation. The jurisdiction over the city parks and over the streets usually lies with different officials, and of course as thorough work must be done in the parks as on the streets, otherwise a part of the work will have been rendered comparatively useless.

Another word, too, about the undertaking of shade-tree spraying as a private enterprise. It may pay an individual for a while to claim merit for a secret composition used in spraying, but in the long run it will not pay. No patented or secret mixture has yet stood the test of comparative experiment against the well-known remedies recommended by the experiment stations. The advertised use of the best remedies known to official economic entomologists will command the greater respect of the most enlightened individuals. Moreover, in Connecticut at least, the proprietor of a secret remedy may find in the near future less than the usual amount of credulity to exist, particularly among those individuals who were last year bitten by a tree inoculating company.

The operations of this company have undoubtedly been brought to the attention of most of the members of this association, so that I need not describe them at length. They bored auger holes into the trunks of the trees to be protected and inserted a secret compound which it was claimed was taken up by the sap and would render the foliage distasteful to leaf-feeding insects. By ingeniously devised tests capital was enlisted and confidence gained, and the company probably made many thousands of dollars last year by inoculating elms at 75 cents a tree, I am told. I am also informed that the State rights for New Jersey were sold for $6,000. I wrote several letters to inquiring individuals last year showing the probable absurdity of the claims made for the remedy, and some of these got into print, with the effect of limiting sales in certain directions. This year I have had an opportunity of examining many trees which were inoculated last year and which were quite as badly defoliated as neighboring trees which were not inoculated. I have further secured, through Mr. Bullard, a quantity of the secret and mysterious substance used in the inoculations and which was taken from nearly dead trees. This was anaylzed for me by the Chemist of the United States Department of Agriculture, Dr. H. W. Wiley, who found that it was composed of nothing but flowers of sulphur disguised in color by the addition of carbon.

I confess that I was surprised to find that this modern and more or less successful fake was but a revival of the old sulphur-plug remedy which has repeatedly been exploded in this country since certainly as long ago as 1830.

THE MAPLE LEAF-LOUSE.

In Springfield the maple is practically as important a shade tree as the elm, and it is discouraging to find that the maple is also attacked by a new and serious insect enemy. On the occasion of my July visit to Springfield I found *Pseudococcus aceris* occurring in very great abundance on nearly all of the leaves of perhaps a majority of the maples in the city. This insect, as is well known to members of this association, is probably imported from Europe, and, while first found in this country eighteen years ago, has only begun to attract much notice since last year. In the writer's article on the species in Insect Life, published last December, the only known localities in the United States were Peoria, Ill., Mount Carmel, Ill., Lancaster, Pa., Jamaica Plain, Brookline, and Norwood, Mass., and Kingston, R. I. All of these localities, except Peoria, Ill., and Lancaster, Pa., were discoveries of last season, and it is very probable that the insect would have remained unimportant and would not have seriously spread had it not been assisted by one or more nurseries. The Norwood (Mass.) locality is a large nursery, and the insect may have been sent out for a number of years from this and perhaps other nurseries. It has evidently been increasing and spreading from tree to tree in Springfield for a long time, and it is practically impossible now to tell how or when it was introduced. In my July trip I did not notice the insect in any city other than Springfield, although, as a matter of fact, I was not looking for it or expecting to find it until after I reached Springfield, and, like the San Jose scale, it has probably been disseminated by nurseries for a number of years, and probably now occurs in many unsuspected localities. In fact, only two weeks ago I received specimens from Dr. Smith, with the information that it occurs abundantly in New Brunswick, N. J.* It is quite likely, in fact, that it has in a number of localities been mistaken for the common cottony maple scale (*Pulvinaria innumerabilis*) and so has not been thought worthy of special notice.

I have so recently set forth the life history of this insect that it will be unnecessary to do more than state that there are three annual generations, the adult egg-sac bearing females occurring upon the leaves and the young larvæ as well, half-grown larvæ of both sexes migrating frequently to twigs and branches, full-grown male larvæ frequently reaching the top of the trunk. Half-grown larvæ hibernate usually at top of trunk and at crotch of the lower limbs. This latter peculiarity renders the insect more easy to treat than it might otherwise be.

*I have since been informed by Mr. A. V. Capen, of Holyoke, Mass., that it also occurs in that city.

A little scraping of the bark with long-handled scrapers, such as are used by Mr. Southwick in his admirable work in the parks of New York City, and the application of a strong whale-oil soap solution, either with a long-handled whitewash brush or even as a strong spray, in the late fall or early spring, will largely obviate difficulty the ensuing summer.

Little more need be said about this insect. That it is a rather serious enemy of the maple no one is in better position to say than Mr. Clark, the city forester of Springfield, and it will be well for those in charge of the shade trees in other cities to keep a sharp lookout for this destructive species.

Fifteen years ago, when Miss Emily A. Smith first studied this insect at Peoria, Ill., she found that it was extensively parasitized by a very minute chalcidid, which she called *Acerophagus coccois*, and which she considered at some length in her paper. Coming to Washington a year or so later, Miss Smith brought specimens of this parasite with her, and it proved to belong to Foerster's genus Rhopus, a form of marked structural peculiarities. I have carefully preserved in rearing jars all of the specimens of the Pseudococcus received since, whether from Illinois, Massachusetts, or Rhode Island, in the hope of again rearing this interesting parasite. I have been unsuccessful, however, until very recently, and was consequently greatly pleased at my first success, on August 5, in rearing a small series from specimens of the scale insect sent in by Mr. Clark, of Springfield. *Rhopus coccois* therefore exists here in Springfield, and may be of some aid to the city forester in his work against the Pseudococcus.

OTHER SPECIES.

The most important of the New England shade-tree insects remaining is the white-marked tussock moth (*Orgyia leucostigma*), and this insect, aside from the gypsy moth, is really the principal shade-tree insect in eastern Massachusetts. This species is so well known and so successfully fought in New York that it is strange that it should be allowed to spread unchecked in most cities. This insect and the fall webworm, a few borers, and, sooner or later, the bagworm (in the northern portions only), may be successfully fought by individuals; and this brings me to a rather good plan which has recently been started in Washington. A number of years ago certain enterprising and public spirited citizens in Brooklyn, N. Y., started a society known as "The Tree Planting and Fountain Society of Brooklyn," its expressed objects being "* * * to promote the planting and protection of trees, the erection of drinking fountains, and otherwise to render the city of Brooklyn attractive." The plan of the society is admirable, but the results as regards shade-tree insects have not been good. In fact, the shade trees in Brooklyn are in very bad condition, as those of us who were at the Brooklyn meeting of this association can testify. This

is probably due to lack of funds, for the society is intelligently managed, and its officers know how to kill insects, even if they are unable to do so.

It seems likely that the very existence of such a society is an inducement to citizens to leave such matters as caterpillars to the society, and in this respect the Washington plan seems better, although on account of its newness it is too early to judge of its workings. The plan, in brief, is to form a tree-protection league among the citizens. This is no formal league or society; it has no meetings, and its members have no way of knowing who the other members are except by looking for results. The matter has been taken up by one of the daily papers, and in every issue the following coupon is published in a prominent place:

Times Tree Protection League—Membership coupon.

Believing that much of the beauty of our national capital is derived from its famous wealth of shade trees, and that these trees are now in danger of destruction by their natural enemies, * * * I hereby promise to do all I can to protect the tree or trees in front of or bordering on my place of residence, and for that purpose submit my name for membership in the Times Tree Protection League.

Name, ————. Residence, ————.

Whether this plan succeeds in Washington or not, it has great merit, and as a means of arousing public sentiment at least it is well worth trying in other cities.

No cities in the world exceed in the beauty derived from shade trees those of the New England States. Nowhere in this country are to be seen more beautiful elms, and maples in particular, than in these New England cities, and no effort should be spared to preserve their beauty.

THE ELM LEAF-BEETLE IN WASHINGTON.

By C. L. Marlatt, *Washington, D. C.*

In the grounds of the Department of Agriculture are a number of very interesting and instructive collections of various forest trees, notable among which is the elm grove, containing thirty or forty trees, representing many species and varieties, largely of foreign origin. For many years back this grove has been regularly defoliated twice annually by the elm leaf-beetle, most of the trees, however, surviving, albeit making little growth. Random efforts have been made from year to year to protect the trees, but without any notable success, and the superintendent of the Department grounds had reached the conclusion that there was no practical remedy and was discussing the removal of the grove entirely. The present season the elms were placed in the hands of the Division of Entomology, which was made responsible for

their protection from the beetles. The reputation of the division was thus at stake, and it was resolved not only to endeavor to prevent serious damage but to prevent all injury at whatever cost.

If the results of remedial treatment reported as thoroughly successful for the more northern range of this insect could have been duplicated here the problem would have been of simple and easy solution. A single spraying, or at most two, for the larvæ, would have accomplished the desired protection. The experience of other years, however, has demonstrated that little if any practical protection is secured by such treatment, largely from the fact of the presence of the pest throughout the growing season instead of for a few weeks only, and, in the case of the Department elms, from the constant renewal of the insects from adjoining groves.

A chronological statement of the work on the elms in the Department grounds during the present summer will give a fair idea of the difficulty of controlling this insect under the conditions outlined, and I doubt if any very great diminution of this labor will prove successful anywhere in the southern range of the insect.

The beetles begin to appear by the 15th of April and toward the end of the month are out in force, before many of the elm trees have put out their foliage. The European elms of the Department grounds are somewhat in advance of the native species in leafing, and thus act as lures or decoys for the beetles, which collect on them in great numbers, sitting about on the buds, waiting with impatience for the leaves to unfold. If undisturbed the insects will attack and riddle the young and tender leaves as fast as they develop. Spraying, therefore, is necessitated as soon as leafing begins. The first treatment was therefore made April 25, when many of the trees showed scarcely a leaf. Arsenate of lead in very strong solution, 1 pound to 17 gallons of water, was used. The beetles are not easily killed, and even at this strength from 10 to 25 per cent failed to succumb. This poison has the advantage that it can be applied at any strength, and, as the protection of the trees was imperative, on the 2d day of May they were again sprayed with a mixture twice as strong as in the first instance. Many of the trees were still white from the first application, and the effects of these two sprayings remained visible on much of the foliage throughout July. The second spraying resulted in the killing of practically all the beetles, those appearing on the trees after that being undoubtedly recent comers, the renewal, however, becoming much less abundant as the season advanced. Few eggs were deposited during May, which, however, was a very cold, wet month and kept the insects throughout the city in check to a considerable extent. Larvæ beginning to appear about the 1st of June, the trees were again treated, the spraying this time being with Paris green, at the rate of 1 pound to 100 gallons of water. The larvæ were never very numerous, not sufficiently so to do any particular damage. The spraying was successful enough, but belated beetles were continually coming in from outside, and toward the end of June new

larvæ began to appear, and, although the effects of the early spraying with arsenate of lead were still noticeable on the leaves, the larvæ seemed to find areas that were not poisoned sufficiently to prevent their development. Another spraying was therefore given with Paris green at the same strength as the last. A few larvæ, a dozen or two to a tree, still survived, however, and transformed at the base of the trees about the 1st of July. These were killed by the application of kerosene emulsion to the trunk and about the bases, at a strength of 1 part emulsion to 3 of water.

The Department trees were thus carried safely through the first brood of the elm leaf-beetle, covering a period of three months. In the meantime many of the elms in the adjoining grounds of the Smithsonian Institution and at various places about the city had had their foliage completely killed. The decided preference of the insects for particular varieties of trees was frequently very noticeable, given trees in many instances having their foliage entirely destroyed, while the surrounding ones were untouched, presenting a very striking contrast.

Under ordinary conditions the Department trees would have had their foliage dead or dry by August 1, and the riddled and skeletonized leaves would soon have fallen. The individuals of the second brood first appearing would have had considerable difficulty in finding subsistence on the few old leaves remaining, but the later appearing and more numerous representatives of the second brood would develop on the beautiful new spring-like foliage which the trees hopefully throw out in late August and early September. The foliage of the Department trees is now old and hard and more or less gummed with repeated sprayings and accumulated dust, a condition which affords considerable protection, and up to the present time the beetles so far developed of the second brood have not seemed to show any decided liking for the trees, very few occurring on them. A careful watch will, however, be maintained, and if there is the slightest indication of the appearance of larvæ another thorough spraying will be given. It is hoped, however, though by no means certain, that the trees will now carry their foliage safely through to the end of the season, with the gradual assumption of the autumnal tints (a phenomenon which has not been observed in Washington for many years), and finally shed it naturally under conditions of frost and rains.

To sum up, the protection secured for the Department's grove of elms has necessitated two thorough sprayings for the adult beetles of the first brood, two for the larvæ of the first brood, the destruction about the bases of the trees of the few larvæ which succeeded in reaching full growth, and the probable necessity of an additional spraying to protect the trees from possible attack of the second brood of larvæ.*

* The beetles did not further attack these trees, but elsewhere the second crop of leaves following defoliation by the early brood of larvæ, was thoroughly riddled by the second brood of beetles and larvæ as in former years.—C. L. M.

This amounts to the spraying of the trees every ten days or two weeks over a period of two and a half months for the first brood, and if this is carried out universally through a district or town the result should be of so decided a character that the second brood would be of no particular moment.

The necessity of prompt spraying at the first appearance of the leaves is emphasized by the experience of the previous year, when the work was postponed until the larvæ appeared. In the meantime the adults had so thoroughly riddled the young and delicate foliage that the appearance of the trees was already seriously marred, and such a quantity of eggs was deposited and larvæ developed that, with the interference of frequent rains, the trees were practically ruined for the season before the poison could take effect.

I am convinced that early spraying for the adults is a most important measure and, for the southern range of the beetles at least, the key to the whole question of control.

THE ELM LEAF-BEETLE IN ALBANY.

By J. A. Lintner, *Albany, N. Y.*

For more than a decade past I have watched with interest the steady although slow progress of this destructive insect northward along the Hudson River Valley. When it was first observed in the State of New York does not appear on record, but as early as 1879 the elms in Newburg (60 miles to the north of New York City) were nearly all stripped of their foliage by "an insect new to that locality," which proved to be this insect. In 1883 many accounts were received of its destructiveness and remarkable abundance in Westchester County, in portions now embraced within the limits of New York City. In 1887 it created considerable alarm in Poughkeepsie, 74 miles from New York and almost midway between that city and Albany. In 1890 the citizens of Hudson became excited over its advent. In 1891 it was seen in New Baltimore, and a year later it reached and commenced its operations in the southern portion of Albany.

When first observed in Albany.—The first example of the beetle to come under my notice was taken on a window within my house on the 25th of September, 1894. It was learned later that its operations had arrested the attention of Superintendent of Parks Egerton in 1893, while engaged in the construction of a new park near the southern limit of Albany. And still later, upon visiting a locality where the insect had been very destructive, a little to the north of the new park, it was learned that the injury to the elms had commenced in the spring of 1892.

Abundant in July of 1895.—In the middle of July of the present year the capture of several of the beetles abroad led me to examine the elms near my residence. At the base of a large English elm (*Ulmus campestris*) large numbers of the pupæ were found lying on the hard, dried ground between the branching roots and on the adjoining brick pavement. Examination of other elms on Hawk street, between Hudson avenue and Hamilton street, while some of the trees were apparently exempt, more of them showed a similar abundance of pupæ, with an occasional newly disclosed beetle among them. In places twenty-five pupæ could be counted to the square inch. Many were also seen in crevices of the bark. They were transforming rapidly, for of five placed in a vial on the 15th two had changed to the perfect insect on the 17th, and the remainder on the day following.

From the fact that no larvæ were noticed either at the base of the trees or descending the trunk it was evident that their descent must have commenced, at least two weeks earlier, or, more probably, in the month of June. Absence from the city the month following June 10 had prevented my making any observations during this time upon the development of the brood.

A second brood.—I was again absent from Albany from July 15 to August 12. On my return a great surprise awaited me. It had been predicted that only a single brood of the insect would occur in the northern extension of the insect in New York, Professor Smith having shown that there was but one annual brood in northern New Jersey, and the statements made of two broods in the vicinity of New York City were believed to rest on inaccurate observations. But here was unquestionable evidence of a second brood in much larger numbers, as might be expected, than the first. Many elms had their foliage entirely destroyed. A notable illustration of the severity of the attack was afforded in the condition of a row of nine English elms in Hawk street, opposite my residence, centrally in the eastern portion of the city. The elms were slender, and from sawing away the lower branches had attained a height of nearly 100 feet. Every leaf had been destroyed except a few which still retained their form, although skeletonized, on the extreme lower branches.* At their bases, against the trunks, the larvæ, in the circular form that they assume when in readiness for pupation, and the pupæ, were lying to the depth of an inch or more in places where they had not been swept away. On any of the trunks hundreds of the larvæ were within range of the eye at any one time, descending to the ground, and many had transformed to pupæ in the crevices of the bark. Opposite to this row and on my own premises was a wide-branching Scotch elm (*Ulmus montana*). The leaves of this had been much less eaten—had not been destroyed, although all showed the peculiar eating away of the epidermis of the under surface and the parenchyma characteristic of the work of the larvæ.

*All of the infested European elms observed in the city have been much more badly eaten toward their tops, as if attack had commenced at the highest point.

In such numbers were the larvæ descending the trunk that for several succeeding days they were repeatedly swept down with a broom before spraying them with kerosene, pouring hot water over them, or sweeping them into piles of leaves for burning. The largest proportion of the larvæ, instead of transforming at the base of the tree, crossed the sidewalk and collected against the side of the house and a brick wall adjacent, or in the crevices at the ends and sides of the adjoining first course of bricks in the walk. Many were observed in the attempt to climb up the side of the house and wall, but they almost invariably fell before attaining a height of 2 feet. At one point, where a small shrub of a few inches in height had sprung up against the house, there were swept up on August 23, from an area of 8 by 10 inches, nearly a pint measure full of the larvæ and pupæ, with a few of the newly transformed beetles. From a partial count it was computed that this collection embraced 9,750 individuals.

Transformations.—A few facts relating to the transformations of this brood may be of value. The time intervening between the descent of the larvæ and their pupation was not noted; it probably did not exceed five days, for of 100 taken August 15 almost one half pupated on the 18th and the remainder on the 19th. Those taken in their curled form pupated within two days, as observed in 150 examples taken from the base of a tree on the 16th, 58 of which became pupæ within thirty hours, and all within forty-eight hours.

The time from the pupa to the imago was seven days, as was observed in several lots that were separated soon after pupation, which in each instance gave the beetle—at first of a pale tint of yellow, with entire absence of black on the elytra—on the seventh day.

The descent of the larvæ was apparently completed by the 25th, none being seen upon the trunks after this date.* The degree of development of the brood at this time was about that of the first brood when observed by me on July 15. From this we may infer a period of about six weeks for transformations of the brood, or about a week less than that which has been recorded for the earlier brood in New Jersey.

Do many larvæ drop from the branches?—Writers upon the habits of this insect have stated that many of the larvæ drop from the tree instead of traveling down the trunk, particularly when the elms have drooping branches. This would seem reasonable, but it was not confirmed by my observations. The Scotch elm on my premises which has been referred to has long and somewhat drooping branches, which extend over an extension to the house; but I have not been able to find at any

* There seem to have been some later than this, perhaps by dropping from the leaves, for they continued to be found in small numbers near the wall until September 9. Pupæ were noticed until the 12th, and the beetle was abroad until September 24. On the 3d of October one came to light in my office in the capitol, of a remarkably dull color, suggesting the idea that it may have been drawn from its hiding place after its development from the last larvæ brought by me within doors.

time during the season a single larva or pupa upon its roof, although fallen leaves in corners offered convenient resting places for them. Nor in the hours that I have passed under the elms in my study of the insect have I seen one of the larvæ upon my clothing or known it to occur on others.

Preference for different species of elms.—The preference shown by the elm leaf-beetle for certain species of elms has often been stated by those who have written upon it. While all agree in the statement that the European elms are more infested by it than our native ones, yet there is conflicting testimony in regard to the liability to attack of the American elm (*Ulmus americana*). Dr. Riley has stated of it in Bulletin No. 6 of the Division of Entomology (1885), "This species is practically free from the ravages of the beetle." In Circular No. 8 (May, 1895) of the same division Mr. Marlatt has written: "The American species, *Ulmus americana*, is notably exempt," but adding this qualification: "All species of elms, however, are attacked more or less, and in the absence of sufficient foliage of the favorite varieties the injury to less palatable sorts becomes almost equally marked."*

Decided preference for the English elm.—The decided preference of the beetle for the *Ulmus campestris* has been strikingly shown during its presence in Albany. A number of trees of this species have died and are being cut down in this the fourth year of their attack, while others—notably the row previously referred to as opposite my residence—will unquestionably share the same fate the coming year, unless conditions should prove unfavorable to the beetles' multiplication. None of the Scotch elms, so far as I have discovered, have been killed, and although the foliage of some of the smaller trees has been about one-half destroyed, there is little probability of their succumbing to the attack, unless they should finally yield to partial defoliation through several succeeding years. Just across the street from the doomed elms above mentioned is a large American elm (their branches almost intermingling) which seems to be entirely free from the insect. Not a larva has been detected upon its trunk or indications of it upon the foliage when its branches were carefully examined from the housetop. A quarter of a mile from this point are the Capitol and the Boys' Academy parks, in which all of the trees, according to the State botanist, are American elms. No trace of the insect was found in these parks when search was made for it during the last week of August. These three species of elms are the only ones which have been identified by me in the infested section of Albany.

The slow spread of the insect.—Perhaps no better illustration of the slow distribution of this insect, when left to its natural spread and unaided by facilities for transportation by railroad or boat, can be

* In the discussion that followed this paper it was stated that the *Ulmus americana* under certain circumstances had been known to be quite as badly injured by the insect as the European species.

given than the fact that in this the fourth year of its presence in Albany it has not yet extended itself over a large portion of the city or to any markedly injurious degree over one-half of its extent of 4 miles as measured from its southern to its northern boundary. As stated by Dr. Riley,* "the insects deposit mostly on the trees nearest to where they develop, and are only partially migratory before ovipositing."

On a short tour of inspection made on August 26 there were found on Myrtle avenue, near Philip street, a portion of which bounds the new park (Beaver Park), in the vicinity of which the insect was first reported, eight English elms which had been killed by it the present year. The feeble leafage put out in the early spring was soon consumed by the larvæ which had hatched from the comparatively few eggs, presumably, that the beetles had deposited under the enfeebled condition of the trees. The next street, Bleecker place, gave two or three dead trees and others badly defoliated. Next in order, Elm street, between Eagle and Philip, showed similar defoliation, and one large elm, between 70 and 80 feet in height, where it was said the larvæ and pupæ had been abundant about two weeks previously, upon which not a single leaf could be seen. Two blocks to the northward, where the attack had probably reached a year or two later and the beetle had not yet become very abundant, the badly eaten trees were putting out a new growth of leaves. A few blocks farther north are the Hawk street elms, previously mentioned, which, in the steadily increasing numbers of the insect, had been so continuously fed upon that not a vestige of new growth was discoverable. The preceding year there had not been the slightest apparent injury to their foliage.

The examination extended over only a half mile, and, although each street crossed showed marked evidence of the injury wrought by the insect, yet a steady decrease was easily to be seen in the successive streets between Beaver Park and the capitol grounds. To the north of the capitol the infestation has not been of a character to arrest public attention, and it is only upon looking for the insect or its work that it is to be found.

Not known north of Albany.—It is reported as not yet having appeared at Menands, 3 miles to the northward of Albany, nor have I learned of its presence in Troy, Schenectady, and other neighboring northern localities, in reply to inquiries made, accompanied by information and illustration that should insure its detection if it occurred. It is proposed to follow up hereafter by personal observation the progress of this insect along the Hudson River Valley until it shall reach Fort Edward, beyond which we do not expect it to extend.

Only a small portion of Albany infested.—It may be stated here that the insect thus far has not spread injuriously over the western part of Albany; in fact, it is virtually limited to the southeastern corner. At

* Bulletin No. 6, Division of Entomology, 1885, page 13.

the time that myriads of the beetles were descending the elms in Hawk street not a single example could be found in Washington Park, three-fourths of a mile west of the Capitol Park, nor leaves showing larval feeding on any of its at least half dozen species of elm. As narrowing the infested area still more closely, on Washington avenue, within three blocks of the capitol and about three-eighths of a mile from the stripped Hawk street trees, are several English elms which are so absolutely free from attack that for this reason it was questioned if they could possibly be some other species, until they were identified as the *U. campestris* by the State botanist.

Recommendations for controlling the insect.—While it is undoubtedly true that the best remedy for this pest is spraying with an arsenical mixture, so as to furnish the larvæ of the first brood with a poisoned diet upon their hatching from the eggs, yet experience has shown that this remedy is not the one to be relied upon or urged for the protection of the shade trees that line the streets of our cities. The labor and expense attendant upon it will certainly prevent its ever being generally accepted, or even an approach to such an acceptance. It is, however, the remedy to be depended upon for the preservation of the elms of our city parks and extended private grounds, where the needed appropriation or the necessary outlay may be made for the purpose. Improved apparatus and methods of application can readily be commanded, by the aid of which the largest elm can be effectively sprayed at a moderate cost.

The lessee or owner of a city residence will not be at the expense of purchasing a powerful force pump and sufficient hose—50 feet or more—to reach up into the tree tops, for the preservation of the two or three beautiful elms that may shade and beautify his premises. True, he might, with a simple and inexpensive force pump and the few feet of attached hose, spray the entire foliage of his trees from his house top, but it would be labor almost wholly lost in placing the arsenite upon the upper surface of the leaf, instead of beneath, where needed.

Instead, therefore, of urging upon the citizens of Albany the impracticable—viz, arsenical spraying—I have contented myself (after indicating the spraying as the proper remedy when it can be employed) with urging in all earnestness, by voice and through the public press, the necessity of a watchful and persistent warfare against the insect in each home where it occurs, beginning at the time when the larvæ are descending the trees and the first pupa, so readily recognizable in its orange-yellow garb, is seen beneath it, and continuing it for the ensuing two or three weeks, or until the last pupa has been killed. The killing of the larvæ and pupæ is simple and involves no outlay, or a very moderate one. It only requires that hot water be poured over them or that they be sprinkled with kerosene. Where the method of making kerosene emulsion is known, this may be sprayed upon them, using one part of the emulsion to four of water.

As somewhat militating against this remedy, it has been represented as requiring frequent, almost daily, repetition. This is not necessary. Intervals of five days will suffice. If all the larvæ and pupæ are killed on any one day, there could be no pupal transformation into the winged insect until the sixth or seventh day thereafter. The simplicity of this method is therefore evident, and there seems to be no reason why through its use 90 per cent of the insects that descend the trees from the elms upon our walks may not be destroyed. In consideration of the many contingencies that attend the hibernation of all insects and the fatality known to exist in that of the elm leaf-beetle, we would not have much to fear or to suffer from the small fraction of the remaining 10 per cent of the brood that might successfully accomplish their hibernation.

Mr. Howard discussed the occurrence of a second brood of the elm leaf-beetle and the habits of the larvæ in pupating. The larvæ bred by him in July in Connecticut were of the first brood. The second brood occurred in very limited numbers in Bridgeport and other Connecticut towns. In regard to the habits of the larvæ in pupation, he said that not above 60 per cent crawl down the trunk to the ground. The others fall from the branches direct to the ground or undergo their transformations in the rough bark.

Mr. Smith corroborated Mr. Howard as to the habits of the larvæ in the particulars pointed out. He described also their climbing fences and transforming in the crevices thereof.

Mr. Southwick gave a résumé of his methods of spraying for the elm leaf-beetle, including careful treatment of particular trees which are especially subject to attack. His experience with the second brood was similar to that reported for Washington. He referred particularly to the larvæ pupating in bunches of grass and weeds. He described the insecticides which he employed against these larvæ.

Mr. Smith asked if estimates had been made of the cost of keeping the New York parks in good condition. Mr. Southwick said no such estimates had been made, and he described the conditions under which he was attempting to keep the 4,000 acres of parking coming under his supervision in a measure free from insect ravages.

Mr. J. W. Clarke, city forester of Springfield, described the habits of the larvæ in pupating in Springfield, stating that the small trees were much the worst affected. He discussed also, in the same connection, the maple leaf louse, and said that the damage from this insect to maples was much worse than the damage from the elm leaf-beetle to the elms. He said that the maple-louse was first noticed in Springfield four years before.

Mr. Southwick said he had found the slippery elms quite as badly eaten as the European elms.

Mr. Riley said that an important new recommendation in the matter of treatment was contained in the paper by Mr. Marlatt, referring to spraying for the beetles beginning, if necessary, at the moment the leaves begin to expand. The method he had always recommended and followed was to postpone treatment until the young larvæ were beginning to hatch. He thought the beetles did not injure the trees materially, and that the application of arsenic to tender foliage was inadvisable. He queried, therefore, whether we are justified by the facts in early spraying for the beetles, stating that he had protected the Department trees on one or two occasions by giving treatment after the larvæ had appeared. He had not, however, been responsible for the elms on the Department grounds, which were under the control of the superintendent of gardens and grounds. The present year was undoubtedly an exceptional one both in the leafing of the trees and the appearance of the beetles. He agreed with Messrs. Southwick and Smith as to the inadvisability of setting out European elms.

In regard to the distribution of the elm leaf-beetle, he was inclined to believe that the explanation of its being now brought into prominence in various New England towns where it had not before been observed was not an instance of sudden introduction, but rather that it had been present and unobserved for years before, and the present year being an unusually favorable one for the beetle its work was rendered noticeable. The elm leaf-beetle is distinctively a city insect, being rarely injurious outside of cities and parks. He had frequently found different trees of the same species of elm affected in a very different degree and attributed this to variations in elms within the species, pointing out in this connection the differences observable in time of leafing and mode of growth of *Ulmus americana*. He was inclined to believe that the second brood in Albany would prove to be a small one and insignificant in its effects, the occurrence of a second brood largely depending on conditions of foliage. If the beetles of the first brood find comparatively fresh foliage, or new foliage following the loss of the first foliage, by reason of the attacks of the first brood, a second brood would be very apt to be developed. The larvæ, he said, are unable to subsist on old dried foliage. He believed much good could be done by cooperation, and particularly if civic pride, as in New Haven, could be aroused. He pointed out the difference necessary in the treatment of larvæ (after they had left the trees for pupation) between trees growing along streets and trees in parks, referring to Professor Lintner's remarks on the treatment of larvæ about street trees.

Mr. Howard said, in reference to the advisability of early spraying for the beetles, that the Division of Entomology was not only expected to effectually exterminate the insect, but also to preserve the appearance of the trees and foliage as nearly intact as possible, thus necessitating spraying to prevent the considerable riddling of the leaves which resulted from the feeding of the beetles before and during oviposition.

Mr. Marlatt said, with regard to the necessity for early spraying, that in the previous year in Washington the beetles had appeared in enormous numbers, and had so thoroughly riddled the leaves that the effect was very marked in the appearance of the trees. He was convinced that early spraying will be necessary where complete protection of the foliage is aimed at, and at the same time will be the most effective method of stamping out the pest. If spraying be left until the eggs begin to hatch, the damage done by the young larvæ before they can be destroyed by the poison, even if they are successfully destroyed in the end, will have a marked effect also in blackening and otherwise injuring the foliage. He pointed out again that the experiences detailed in his paper were confined practically to the experiments of the present season, and did not include any of the earlier experiments conducted by Professor Riley.

Mr. Webster, remarking on the great extension of our knowledge of the distribution of the elm leaf-beetle the present season, and on the fact that he had recently noticed it north of Salem, Mass., said that it indicated to him that we are, after all, lacking in accurate knowledge of the distribution of important insects. He gave some personal instances further illustrating this idea.

Mr. Fernald gave an account of the Amherst experience with the elm leaf-beetle. He said he had reported to Mr. Howard as late as this year that the insect was unknown at Amherst, and in fact it had never been collected in former years by any of his many student collectors or assistants in entomology. Yet the present season, after he had reported its nonoccurrence, he found it in numbers within a short distance of his insectary. He even queried if this might not be a recent jump of the insect, rather than an excessive development after possible presence in small numbers for some years.

Mr. Smith said that he was inclined to believe that the most good would result from early spraying for the beetles, rather than waiting until the larvæ put in an appearance. Ordinarily the leafing of the elms is a little in advance of the appearance of the adult insects in spring, but the present year was an unusual one climatically and this condition was reversed, the beetles appearing in advance of the unfolding of the foliage. He described the elm trees at New Brunswick and the difficulties attending their treatment on account of their large size; also the trouble experienced as the result of frequent showers. He had employed the present year arsenate of lead, using it at the rate of 15 ounces to 80 gallons of water. He had sprayed the elm trees on the college campus three times, the last treatment just as the larvæ were hatching. This spraying effectually protected the trees treated, the benefit being indicated by the fact that other trees in the neighborhood were very badly injured. He had seen no trace whatever of a second brood of larvæ the present season. He emphasized the importance of keeping the first foliage on the elms, for the reasons

pointed out by Professor Riley, namely, the inability of the larvæ to develop successfully in any numbers on mature and hardened foliage. He said that the explanation of the second brood of beetles reported by Dr. Lintner as occurring in Albany, if true, was undoubtedly due to the presence of comparatively new and fresh foliage.

AFTERNOON SESSION, AUGUST 28, 1895.

Professor Fernald opened the discussion on the gypsy moth again with an extended account of the operations up to the present time, illustrating his remarks with specimens and photographs. He has furnished the following stenographic report of his remarks:

NOTES ON THE GYPSY MOTH IN MASSACHUSETTS.

By C. H. FERNALD, *Amherst, Mass.*

[Stenographic report.]

It may be needless for me to tell you that the gypsy moth was introduced into this country about twenty-six years ago by Mr. Trouvelot, living in Medford. He was, as you know, a celebrated astronomer, and he had an idea of experimenting with this and other silk-producing insects with a view of making silk profitably from them. I wrote to him to know how this insect escaped from him, but received no reply. I was informed a short time ago that a gentleman was with Mr. Trouvelot in Paris not long before his death, and Mr. Trouvelot told him that he brought the eggs over from France, and when they hatched he put them on a shrub near his house and covered them with a mosquito net, and that a storm came up in the night and tore the net to such an extent that the insects escaped. I suppose that this is the way that the insect escaped, although we have another story. The insect became quite abundant and spread from Medford rapidly, attracting a great deal of attention in the immediate vicinity, but the people lost sight of the fact that it was a foreign species and took no measures to rid themselves beyond what they could do personally. They tell us of the abundance of these insects; how they ate all the foliage from the trees, and continued this until the trees died. One gentleman says they spread over the side of his house so that it was impossible to tell the color of the paint; another, that when he started to his place of business it was impossible to step anywhere on the street without crushing the caterpillars.

I have a box here containing specimens of the gypsy moth in its different stages—an egg cluster; two eggs, separated; the different molts of the larva; pupa, male and female; male and female moths, spread and unspread. These boxes were distributed about the State and to experiment stations in adjoining States for the purpose of instruction. Many insects have been sent in order to ascertain whether they were the gypsy moth or not, and it seemed desirable to inform the people as widely as possible, so they would know what the gypsy moth is, and this was one of the methods used to give the desired information.

I have here a male and female and two hermaphrodites. One of the latter is badly rubbed, but the form of the wings and the antenna on the right show it to be a male; on the other side the wings and antenna show it to be a female. I have left directions with my assistant, Mr. Kirkland, to make a critical dissection of a specimen, if one should be found, as I thought it would be of interest to know just what the internal structure of the hermaphrodite insect is.

The gypsy moth spread from that central locality—the locality of Mr. Trouvelot's home—to more distant points, and grew so much more numerous that at last the people began to feel that it was necessary to do something.

In 1889 the outbreak in Medford was so great and they were doing so much damage that specimens were sent to the secretary of the board of agriculture, in Boston, and he sent them to the experiment station at Amherst. At that time I was abroad, and my wife and son had charge of the work. They identified the insect after a little trouble, not being aware at first that it was a European species, and wrote me immediately at London. I then got what information I could in Europe of those who could give me the best advice.

After my return I went to Medford and visited the territory. There was a region of perhaps a square mile in which the trees, trunks and branches, were literally covered with clusters of eggs, so that they were yellow. It was surprising to see how great a quantity of eggs there was. After what I had been told by the entomologists in Europe, I felt quite alarmed about the matter. I thought we had an invasion that demanded careful attention. Accordingly, I prepared a bulletin on the subject, and the secretary of the board of agriculture was kind enough to add to our funds so that an edition large enough to send a copy to each voter whose name and address we could get in all that region was printed, and this bulletin I presume has been seen by most of you. This closed my official connection with the work for the time.

I do not know at present who called the attention of the governor to it, but he made mention of it in his address and brought the matter before the legislature. A commission was appointed, but it was a political commission and I gave no advice in the matter.

The work of the first commission was not satisfactory to the governor, and that commission was discharged and the work put into the hands of the board of agriculture of this State. The board took it upon itself as one of its duties and appointed a committee on the gypsy moth. This was the second year. An appropriation of $25,000, was made the first year and before the year ended another appropriation of $25,000 was made. With Mr. Sessions I spent a day looking over the territory. As soon as the committee was appointed by the board of agriculture they called in several experts. I think the gentlemen called on that occasion were Professor Riley, Mr. Scudder, Mr. Henshaw, and myself. Mr. Henshaw could not be present. The others were present and gave

their best judgment and advice. I certainly advised as it seemed best to me, and, as it proved, my advice coincided with that given by Professor Riley.

The committee then appointed Mr. Forbush as field director. The committee was advised to import parasites. I was then called from Cape Cod to go over the ground and make a critical examination and advise in regard to the matter. After making a close study and finding that our native parasites were at work on the insect it seemed to me that it would be wise to wait a little before attempting to import others, as there seemed to be a danger that secondary parasites might be imported with the primary ones and thus undo all that we attempted. My advice was taken in that case, whether rightly or wrongly remains to be seen. I was then asked to act as entomologist, and in an unhappy moment I consented, and, although I have since resigned, the committee has declined to accept my resignation and I still hold that position. I was at first prone to judge of this foreign insect by the habits of our home insects, and I am not sure but that Professor Riley and I both had the same inclination.

I have been studying the habits of this insect from that time until now, and have not finished yet. We find out something new and striking nearly every week, and things that we were not expecting to find have developed.

Experiments with Paris green were made the first year, and I have no doubt that vast numbers of caterpillars were destroyed, but I know in many cases I could go to a most thoroughly sprayed tree two, three, or five days afterwards and find living caterpillars that would transform, and this on trees where Paris green had been used at the rate of 1 pound to 150 gallons of water, which was as strong as the trees would bear, as shown by a slight burning of the foliage. We tried other substances, as Paris green and lime, and then secured a chemist to experiment with different insecticides. It would be impossible to state the different substances that were tried, many of which would kill the insects and at the same time kill the trees. Other things that would kill the insects and not injure the trees cost so much that we could not use them; so there was some difficulty with most of the discoveries he made. At last the chemist hit upon arsenate of lead, and this has proved quite valuable. I regret to say that this young man, contrary to our expectations, has applied for a patent. The Commonwealth of Massachusetts has entered a protest. The authorities have tried to get information from the Patent Office, but were informed that it is not customary in the Patent Office to give out information. Whether the chemist will succeed in getting the patent I do not know, but I hope not. I wish him no harm, but I want this Commonwealth and other States to have the advantage of any discoveries we may make. No man can now be employed on the gypsy moth work or be paid by the State until he signs an agreement that all his discoveries

shall go to the advantage of the Commonwealth of Massachusetts. So long as the Commonwealth pays for the work I think it is right for our citizens to enjoy the full benefit of all discoveries made by its employees.

We have tried various experiments and find some few to be exceedingly useful, as, for instance, where there are valuable trees on private grounds we can use this arsenate of lead in large quantities without injury to the foliage and yet destroy the caterpillars. In other cases where the land is covered with shrubbery and is of small value we can burn it over. We have a method of burning which I can not describe. It approaches as near to Tophet as anything I can think of. It is the most terrific blaze that I have ever seen. It is used where we want to force the heat down into cavities or places where it would be impossible to reach the insects otherwise. In woodlands the insect crawls down among the rocks so far that it is beyond the influence of any fire that we are able to get up. But if we burn everything in the territory around and leave only here and there a tree they will hatch in the spring and crawl up the trunks of the trees. We have another method of attacking them at that time. We put bands of burlap about the trees; this has proved to be exceedingly useful. We found that they feed only in the night after they are about half grown. They descend the trees toward morning and go into any concealed place they can find. We cover the cavities in the trees with tin or other material and leave no place for the caterpillars to hide except under the bands of burlap. The men go around and destroy all the caterpillars under the bands, and in a few days or in several days they will clear that tree more effectually than it could be cleared at any other time except in the egg state.

I must refer to the statements made by Mr. Scudder at the time of the meeting of these experts. He stated that this insect passed the larger part of the year in the egg stage, and it seemed to him that the proper method of fighting them was in that stage. It has proved that he was correct; that we can do very effectual work in destroying the eggs. We have discovered a method of destroying the eggs which, to our minds, is far superior to those used by the Germans and Austrians in fighting the nun moth. While they cover the nests with raupenleim, we use a combination of creosote oil and carbolic acid. Experiments have shown that it destroys the life of every egg. Although the egg clusters are covered with hairs from the underside of the abdomen of the female, yet this mixture penetrates and destroys the eggs. In no instance have we bred a caterpillar from eggs treated in this way, and at least five hundred egg clusters have been used in the experiments to test the material.

By authority of the State, we have prepared a book, which is now going to press, in which we are giving all the facts that we have gained on the whole subject. We want to put in all that can be learned from

European works in regard to the gypsy moth, and have been going over the European literature, getting information from every source. This report will contain several colored plates as well as plain ones, and will give many things of special scientific interest. It is now in the hands of the State printers.

We have had a vast deal of work in cleaning trees, stone walls, and fences. These insects, when they reach the adult stage, go down the trees and into cavities that are almost inaccessible. One must look in every conceivable place. It takes time and is expensive.

MEANS OF DISTRIBUTION.

It is a remarkable fact that the females do not fly. I was very much interested in a paper read on the life history of the gypsy moth before one of the entomological societies of Europe, in which the person who had worked out the life history stated that the female has a pair of forceps by means of which she pulls out the hairs from her body and puts them upon the clusters of eggs, and this statement was really taken in sober earnest by every member present, so far as I was able to judge. It was stated that we claimed the female moth does not fly, and they claimed that it was a lack of observation in the matter; that if we would observe late in the night we would find that the females fly as rapidly as the males. We have had observers working all night long. We have had trees surrounded by a sort of Babel's tower, so the observers could go up and watch the individuals. We marked the caterpillars and experimented on the methods of marking them to determine one which would not injure them. The marked caterpillars were watched to determine the time they started; how they went, whether straight or whether they hesitated; how they went up the tree; where they went; how long they stayed, and whether they came back to the place from which they started, or whether they lost their track and went somewhere else, etc.

Those men who were discussing the matter did not know what we had been doing. I have been criticised because our reports were not full, because all this has not been given. These reports have been simply for the legislature, and how many members of the legislature will read a report of any length when you are asking for money? The more money you ask for, the less they will read your report, and the committee said these reports must be very short. Nobody knows better than Professor Riley how this matter is, for who has had more experience than he in getting appropriations? They look upon you in a doubtful way, in a very different way from an audience like this.

The territory over which the insect is spread was stated in my first report to be a mile and a half long; but I stated then (and I had only one day in which to inspect the territory) that the insect was in all probability spread over a larger territory. We are able to tell from the character of the nests (in fact, some of our men are so expert that they

can tell almost to a year) the age of a colony. We found that the territory over which they were spread was a large one and that it would be a year or more after the present work was begun before we would be able to locate the outer colonies. We do not say a whole town is infested; we can only say the insect occurs in that town. So long as they are left the colonies will be spreading until the whole town will become thoroughly and fully infested. The territory infested is about 200 square miles, including thirty towns and cities. A part of that territory we think has been cleared. Colonies which were known to exist in certain places three years ago show no trace of the insect. Therefore we think we have reason to believe that these colonies are really exterminated; but I doubt if I should want to say they are exterminated until we have watched them ten years.

We have been giving especial attention this year to the food plants, and have a list of over three hundred plants that this insect feeds on in Massachusetts, some not natives of this country. Some cotton plants were brought from the South, and we find that it is a very excellent food plant for them. They revel in it; in fact, they ate the whole thing up. If they should get into the South I think they would be capable of committing sad havoc there.

Our field director is an ornithologist, and he has been giving a great deal of time to the subject of birds. He has been working it out very carefully, and has much he could say if it were so desired.

We have been giving a great deal of attention to predaceous insects with a view of breeding predaceous beetles. We have some eight or ten of these, and they are certainly doing good work. Every report on entomology that you take up contains a list of predaceous insects. We have some that are not given in these reports. We have about thirteen species of true parasitic insects. I sent the Diptera to Dr. Williston for determination, and after giving them a preliminary examination he told me there were so many species of this genus and so many of that which were probably new.

Parasitic plants is a subject we took up. I talked over the matter with Dr. Thaxter and Dr. Farlow, but they gave us no encouragement in regard to the matter. Dr. Thaxter said, "Why don't you use Paris green?" We gave him our experience with this insect—that it would eat more Paris green than the foliage of the trees could bear and still transform and lay its eggs, which would give rise to caterpillars the next year. I did not believe it at first, and I doubt if any of you would have accepted it. I took some of the insects home and fed a large number of them, and I could not believe my own results and had my assistants try it again. I had it tried in the field, and I tried it three years in succession myself, and I am obliged to say that you can not kill this insect with Paris green unless you use more than it is possible to put on the trees without destroying the foliage.

As the females do not fly, of course the distribution in the adult stage is very limited. But the caterpillars in the early stages spin down

from the trees and are carried long distances on vehicles, cars, etc. There are several lines of cars running through the infested district. We found it necessary to clean all the trees along the lines of cars and where the cars stopped in the infested region, and many a place did we have to clean out which cost time and money, and sometimes we had to exercise the authority which was given us by the State to prevent material being carried away by the railroad companies, lest it should be infested with the eggs or caterpillars.

These caterpillars before the first molt are different from what they are after this molt. They have two sets of spines, those on the upper part of the body being smooth and pointed, with a balloon-shaped swelling at the basal third filled with air or gas, which probably has quite a lifting power. The nun moth of Europe has the same structure in its early stages, and some claim that the caterpillars are swung off in the air and float away by means of the lifting power of these miniature balloons on the spines. We have never demonstrated that it gives any aid in the distribution of the gypsy moth larvæ, but I am not prepared to say that it does not have a lifting power.

The distribution is mainly in the caterpillar stage, when they get upon moving objects. We find that the people who drive about in the infested region carry it around the most, as doctors and milkmen, who are going from house to house. They distribute this insect unconsciously and unintentionally. We almost invariably find their premises infested.

We tried experiments to determine the distance a newly hatched larva would crawl before it died of starvation. The thought I had in mind was that if we knew the outer limit of the territory infested by a colony we would then know how wide a belt it would be necessary to burn to protect the territory outside. We put newly hatched caterpillars on a level table, on white paper or ordinary newspaper, thinking that that would give them quite as good a chance to travel as they could have in nature, and had persons follow behind them with a lead pencil, with instructions to let them take their own course and not to punch them along. Although the caterpillars took a peculiar course, we got the number of feet they would travel before they died and the number of hours it took them to travel the distance. One traveled 92 feet in 10 hours, one 143 feet in 12 hours, and another 144 feet before it died. I had the impression that if food were placed in the immediate vicinity the caterpillars might perhaps direct their line of travel in the direction of the food, but they did not. They did, however, travel invariably toward the light—toward a window or lamp. I am not surprised at that, because where these caterpillars are hatched, in the cavities of trees, they naturally travel toward the light, and are governed by the light more than by the odors or proximity of food.

We also tried to ascertain how much a caterpillar would eat. These experiments were performed in the winter and in confinement. One

female ate 212 square feet of lettuce leaves from the time it hatched until it pupated. One male ate 110 square feet of lettuce leaves during the same period. Dr. Gray gives the leaf surface of the Washington elm in Cambridge as 200,000 square feet. That represents both sides of the leaf. Taking 100,000 square feet, if 179 females are allowed to lay their eggs, and the eggs hatch, and the caterpillars reach maturity without any accident, they would be sufficient to defoliate that tree. And yet in Medford I found trees that were literally yellow with the egg clusters.

We tried experiments in assembling, with a view of ascertaining whether it would be possible to destroy all the males in a given region, so that no fertilized eggs would be laid. We took a somewhat isolated colony and placed the virgin females in traps or cages. The cages had gauze over the sides, so that a draft of air passed through and the odors would be carried away, and the males would fly up from the leeward side and would come in contact with the "sticky fly paper" on the sides of the cage, and would be taken the next morning and destroyed. We took enormous numbers of males in that way. It would seem as though the females would lay unfertilized eggs, but, strange as it may seem, they were found to be fertile, and we gave it up as an impracticable thing. It was interesting and settled the question to my mind. We found that the males would mate with four females in succession, so it was not necessary to have as many males as females.

The people of the State of Massachusetts saw they had a stupendous undertaking on their hands, and I think you will all admit that a magnificent fight has thus far been made. The State has already appropriated $525,000, and the last appropriation is not yet all expended. We in Massachusetts are not the only ones interested in this matter. Every citizen of the United States is interested. In Europe it extends as far north as Riga; occurs abundantly in Moscow, but not at St. Petersburg. It occurs south in the islands of the Mediterranean; is abundant on the north coast of Africa; occurs in southern Siberia as far as the Amoor: and my colleague, Professor Brooks, found this insect in Japan—one of the Japan species—and I infer from his reports that its habits there are much the same as here.

I have been severely criticised because I have not favored the importation of parasites. I may be wrong. If I have made a mistake I myself must bear the responsibility. I never dealt with abler men than those of this committee. If there is any credit it is due to them, and if there have been any grave mistakes during the past few years the responsibility lies with me. The committee has considered carefully every suggestion that I have made. I have not made any rash or hasty statements, but have given them advice as to the methods of procedure, and they have almost invariably followed my advice. I felt that there was a great responsibility upon me, and I asked them to invite entomologists from other States to go over the territory and

inspect the work. Accordingly ten entomologists were invited, nine of whom visited the territory. We took them over as much of the territory as possible—over the worst places and the best places. I wanted to share the responsibility and I wanted advice. They gave us advice, and a part of their reports has been published in the reports of the committee. Some of the suggestions have been adopted; others have not. We were advised to cultivate parasites. The law makes it obligatory upon us to exterminate the insect, so we must kill every caterpillar, whether infested with a parasite or not, and in that way we are exterminating parasites as well. If the State directs to merely hold the insect in check, then is the time to work with parasites.

In response to a request, Mr. Kirkland, assistant entomologist to the gypsy moth commission, gave a verbal report on the more recent experiments with insecticides conducted by the commission. He said that no success had been had with insecticides until the arsenate of lead had been devised, and even this, at the rate of 10 pounds to 150 gallons of water, effected the destruction of only about 50 per cent of the larvæ. He described his examination of the alimentary canal of the larvæ with a view to determining the probable action of the juices contained in various parts of the canal on insecticide substances. He had found the juices strongly alkaline, and of the substances which seemed most likely to be acted upon by an alkaline liquid he had considered the cyanides of different metals to be the most promising. The cyanides of lead, antimony, copper, zinc, iron, manganese, mercury, etc., were considered. The cyanides of antimony and copper, on theoretical grounds, seemed to promise best. The cyanide of antimony was totally without effect at the rate of 10 pounds to 150 gallons of water. Cyanide of copper was fairly effective, but too expensive for practical employment, 3 pounds to 150 gallons being equivalent to 1 pound of Paris green to 150 gallons of water or 3 or 4 pounds of arsenate of lead to 100 gallons. Even where no practical results seem to have been obtained, as in the above series of experiments, he pointed out the value of the negative results; in that the very fact that the merits of these substances have been tested our knowledge of the substances valuable for insecticides is better understood and limited. In connection with the various experiments with insecticides he had occasion repeatedly to emphasize the extreme vitality of the gypsy moth larva and its immunity from the action of poisons.

Mr. Riley discussed the gypsy moth question at considerable length. He said he had always been much interested in the gypsy moth work, and referred to the original conference called by the State board of agriculture of Massachusetts, giving an account of this meeting and of the suggestions made by himself and others as to means of controlling the insect. These suggestions were necessarily based on experiences with our well known common insects having somewhat similar

habits, and had no basis in any actual experience with the insect under discussion. He had recommended and believed that the use of the arsenites is one of the most practical and effective means of control. There can now be no doubt, however, that this insect is an exceptional one and probably can not be controlled by means which are quite effective against other insects, enemies of our trees, having similar habits. Emphasizing the great damage which may be done by this insect, he was convinced that its control and destruction are not only extremely necessary to the State of Massachusetts, but are also of national importance. He had always been in favor of extermination rather than of attempting to limit and control, but he pointed out the very great difficulty of exterminating the species if the work is mainly directed toward the destruction of the eggs, referring in this connection to his early statement in this regard, in which the destruction of the eggs had not been deemed of prime importance. He thought, however, that in this particular he had been too extreme. He pointed out the absolute futility of any efforts at extermination which did not promise complete results. All that he had said in criticism of the commission had been relative to the operations prior to Mr. Fernald's controlling connection with the work. He heartily appreciated the value of the present methods as detailed by Mr. Fernald. He felt that if at the outset a supreme effort had been made, with the aid of a very large appropriation, complete extermination of the insect could have been accomplished. He gave a summary of some early work and his criticism of it. He was somewhat inclined to question whether we are now justified in working on the basis of extermination through a State commission, or whether it would not be better to encourage the efforts of private individuals wherever the insect occurred, as is the case with other insect pests. He complimented very highly, however, the present work of the commission. In discussing the subject of parasites, which had been referred to by Mr. Fernald, he was not inclined to agree with the idea that the aim of the commission at complete extermination detracted at all from the necessity of undertaking the importation of foreign parasites. He said that such introduction could be accomplished at comparatively slight expense and would aid just so much the object of the commission, pointing out also the greater usefulness of European parasites over native ones if introduced without secondary parasites. This would be particularly evident if his idea of the greater value of the destruction of the larvæ rather than the eggs were conceded.

In illustration of the great weight and value of Mr. Riley's ideas on this subject, Mr. Fernald referred in the most complimentary way to the value of his long years of labor in the field of economic entomology, which had resulted in a store of information used and appreciated by all the workers of the world at the present day. He gave some statistics of the injury capable of being done by the gypsy moth in the State

of Massachusetts, basing his deductions on the value of farm products and the estimated value of forest and shade trees (Mr. Lintner interjecting in the latter connection that the Saratoga elms were insured at $500 each). Taking the probable injury from this moth as a basis, he pointed out that a comparatively trifling tax only would be necessary to raise a sum sufficient to control the pest, and was very strongly of the opinion that the work of the commission should be upheld and continued.

Mr. Howard said he was familiar with the work of the commission and had gone over the territory and examined the methods of procedure in detail somewhat recently, and was convinced that anyone, seeing the operations and the results already reached, would be impressed with the fact that the work is now being done in the best possible way and according to methods which are most likely to accomplish the ultimate extermination aimed at. He offered a resolution regarding the work of the commission, which was subsequently acted upon by the association. (See infra.)

Mr. Lintner said he had been one of the first called to inspect the work and the conditions of the work, and had been deeply impressed with the amount of exertion necessary and the difficulties of successfully prosecuting it. He also had been most favorably impressed with the value of the methods at present employed. Whether ultimate extermination would be accomplished or not was at present, of course, merely a matter of opinion, but he was convinced of the necessity of continuing the work on the basis of extermination rather than mere control.

Mr. Lintner presented the following paper:

THE STRIPED COTTONWOOD BEETLE.

By J. A. Lintner, *Albany, N. Y.*

The wonderful multiplication of species of insects not usually injurious, or, indeed, even rare, as the result of the cultivation of a crop on a large scale and in extended areas, is often brought to the notice of the economic entomologist in appeals made to him to suggest remedies available against the ravages of some (to the culturist) new insect pest.

A recent occurrence of this character is the threatened destruction of the basket-willow industry of Onondaga and some others of the western New York counties from the ravages of the insect which has been known for the last score of years as the striped cottonwood beetle. Scientifically it is *Melasoma* (*Lina*) *scripta* Fabr.

In May of 1894 there was sent to me by Internal Revenue Collector Von Landberg, from Syracuse, N. Y., a bottle of beetles, with the information that the willow raisers of Liverpool, N. Y., and Salina and neighboring localities were experiencing great trouble and serious loss from the ravages of a beetle which was destroying acre after acre of the basket willow.

It was readily identified by me, and the request for its identification and a remedy for it was answered virtually as follows:

The beetle is a member of the destructive family of leaf-eating beetles known as Chrysomelidæ. It has received in the Western States the popular name of the cottonwood beetle from its special fondness shown for the foliage of the cottonwood tree (*Populus monilifera*). In recent years it has become almost equally injurious to willows. It was first brought to public notice by Professor Snow in the year 1875 by its widespread destruction of the cottonwood in Kansas, and a few years later (1878) by Professor Riley in his accounts of its more serious ravages in Nebraska and Dakota, where the rapidly growing cottonwoods had been extensively planted by new settlers in the treeless plains of that region. Many thousands of trees were killed through their defoliation for successive years, the remnants of the leaves turning black and shriveled, as if struck by "fire blight."

The beetle has never before, so far as known to me, appeared in injurious numbers in the State of New York. It has not been a common insect with us. Indeed, it had never come under my observation until in the year 1890, when, during the early part of July (4th to 7th), both the larvæ and the beetles were found by me in Keene Valley, in the Adirondack Mountains, feeding on willows growing along the banks of the Au Sable River. Nearly a hundred were collected for the State collection. Not a single example of the insect has since been seen by me in the five following years of collecting in that locality.

Both the larva and the beetle feed upon the willow. * * * The larva is at first black; when full grown it is of an elongate form and measures nearly a half inch in length. It is then of a dingy yellowish color, with head and legs shining black, two rows of black spots on the back, and in line with these a row of black tubercles on each side. These tubercles, when the larva is disturbed, throw out from each one (for its defense from its enemies through the pungency of the odor) a globule of a milky fluid, which is drawn into them again when the alarm passes away.

The beetles are oval, more flattened than the chrysomelids usually, and vary in length from two-tenths to three-tenths of an inch. The head is black. The thorax is mainly black centrally, with its two outer sides bordered with red. The wing covers are dull yellowish, with about seven black spots and lines, and the inner margins joining over the back, also black. The legs are yellow and black, and the body beneath blue-black.

The injurious character of the beetle is intensified from there being two or three or more broods of it each year. The brood now present with you is from eggs that were laid on the willow early in the season. Under favoring conditions for multiplication the subsequent broods will be more numerous and of course more destructive.

It is fortunate for your willow growers that we have a comparatively simple remedy for this new willow pest, otherwise the industry so important to your people might be seriously impaired. A thorough spraying of the willows with Paris green in water should kill all the insects in their larval and perfect stages that feed upon the leaves.

Directions for preparing and using the spraying mixture and information regarding pumps available for the purpose accompanied the above.

In some correspondence following only a partial success was reported to me as the result of the spraying recommended. The increase of the insects could not be kept down, and consequently in several instances entire fields of willow had been destroyed and plowed up. Some other suggestions were made by me and were, I believe, faithfully tried.

Early in May of the present year I was notified that the ravages of the insect had commenced, that it was operating more numerously and seriously than ever before, that the willow growers were discouraged, and would be compelled to abandon the culture unless the insect could be controlled. My presence was requested; but I was prevented from making the desired visit at the time, and it was necessarily deferred until the month of August. Although then too late to see the active operations of the insect, I was able to look over the ground thoroughly; to meet and confer with the willow growers and basket makers; to learn from them the extent and importance of the industry, its threatened destruction, and what was being done to avert the calamity.

The willow grown is the European osier. It is propagated from pieces cut by a machine into 9-inch lengths and set 6 inches into the ground. These are placed about 14 inches apart, in rows 3 feet apart, permitting the use of a cultivator between them and hoeing as often as necessary. The fields are liberally enriched with barnyard manure. An ordinary soil is as well adapted to its growth as a wet one. It can be cut for use the first year, but is not in full vigor until the third or fourth year, and continues to yield good crops for ten or twelve years, when it should be plowed up and set out anew. A good growth will average about 6 feet in height. It is cut in November, when the leaves have fallen. It may then be steamed for loosening the bark, and the peeling is done by children in the shops of the basket makers.

The steaming—submitting to exhaust steam for about twenty minutes in large boxes holding 2 tons of the willow, placed on a heavy truck for convenience in gathering and delivering it—is done by two establishments in Liverpool, one of which, that of Mr. A. H. Crawford, treated 1,800 tons last year.

The green willow is worth from $15 to $45 per ton; when peeled and dried, 6 cents a pound. The growers raise from one fourth of an acre to 60 acres each. Mr. E. P. Black, a very successful grower, who finds an abundant return for the labor bestowed upon his crop, cultivates 20 acres. The yield is from 3 to 8 tons per acre. About 500 acres are grown in the town of Salina, Onondaga County.

In addition to Onondaga County, where the crop is grown the most extensively, it is also grown in Oswego, Oneida, Madison, Cayuga, Schuyler, Seneca, Wayne, Ontario, Livingston, Monroe, Genesee, and Wyoming counties, but I am not able to give the extent of cultivation in the several counties or the comparative amount of injury from the willow beetle in them.

As before stated, the willow of western New York is not a native, but has been introduced from France. It is the osier, or basket willow of Europe (*Salix viminalis*). A German willow is grown to a limited extent. It is a taller and stouter plant, sometimes attaining 12 or 14 feet in height. It is not so subject to insect attack, but it is less serviceable for baskets, being coarser, less pliant, and only adapted for the heavier bottoms of baskets.

A small proportion of osier is imported annually from France, Belgium, and Germany, but it is decidedly inferior to the home-grown.

This industry is at present the sole one of Liverpool, since the salt industry, proving unremunerative, has been abandoned. About 150 families are engaged in the manufacture of baskets, employing the children and often the entire household. It has been a profitable industry, as shown by the fact that most of the dwelling houses in Liverpool are owned by their occupants and have been paid for out of its proceeds. The amount invested in this place in the growing and manufacture is estimated at $1,500,000. The above perhaps uninteresting details are given to show the economic importance of the insect ravages which I shall bring to your notice.

This willow-feeding insect was known as injurious in Onondaga County as far back as the year 1875, when 57 acres of willows were destroyed in a swamp in Clay, Onondaga County. This was discouraging to the willow growers; fewer willows were grown for a time thereafter and but little was heard of the insect. Our first recent information of it is that a gentleman who collected insects in Liverpool took some of the beetles on basswood in 1887. From that time it seems to have been steadily on the increase, but not until last year (1894) had it multiplied to such an extent as to claim general attention. Its destructiveness the present year is greatly in excess of that of the preceding. It is stated that the cutting of this year will fall short of that of 1894 by 1,000 tons. A grower who grew 65 tons in 1894 will this year cut but 25 tons. Many fields have been abandoned and will be plowed up, and others will only be cut in order to permit of a possibly more successful growth another year. There is widespread discouragement and a fear that the industry, which is the sole support of the town, is doomed.

In inquiring into the life history of the insect no definite information could be given me of the time required for its transformations or the number of the broods. The number is generally thought to be three. The hibernating beetle makes its appearance toward the last of April, and is in readiness to attack the sprouts as soon as they start in May. It is said that they do not feed on the leaves, but at first only upon the ends of the tips. When the willows are more advanced, with the second brood of beetles this tip-feeding habit becomes more harmful, as they then girdle the twig by eating away the bark, causing the tip to bend over and die, necessitating the putting out of one or more side shoots, which seriously impairs the value of the plant, producing unsightly bends, necessitating trimming before use, and materially interfering with the stripping of the bark. The larvæ feed only on the leaves. The eggs being laid on the under surface of the leaves, in clusters averaging about 40, the larvæ, on emerging, in company eat away the epidermis and the parenchyma between the small reticulating veins, leaving the upper epidermis unbroken. This feeding habit makes a

more thorough and careful spraying of the arsenites necessary, in order to reach the under surface of the leaf and kill the larvæ in their first stage. Later they separate and eat through the leaf.

So familiar are the growers with the aspect of the larvæ in their several moltings that the only name by which they are spoken of is "hangers." The beetles are known as "hard shells."

I was disappointed upon finding at my visit made on August 22 that the beetles had already gone into their winter quarters, for Mr. Bruner, entomologist of the Nebraska Agricultural Experiment Station, in his notice of the insects in Station Bulletin No. 14, has stated that "the perfect insects in fall, after the first heavy frosts, leave the cottonwoods, poplars, and willows, where they had been feeding, and seek some shelter." Only about a half dozen could be found by careful search to show me. A few weeks before the air had been at times filled with them in the streets of the village, "gathered," it was said, "in swarms, like companies of gnats and midges." They had commenced to retire for hibernation during the first half of July, and by the 1st of August nearly all had disappeared. They are now to be found in old stone walls, under rubbish of all kinds, in the crevices of rocks and stones, and occasionally in houses.

Should it be desirable to attempt the destruction of the eggs of this beetle, it is of importance to know that the first deposit is by no means confined to the willows, but that they are placed on various plants and weeds, and even on other than vegetable growths, but presumably in close vicinity to the willows. As showing the abundance of egg clusters, it was stated that 700 clusters had been picked from a row of willows 20 rods long in passing over them once; and, as illustrating the abundance of the beetle, 3 bushels of them had been gathered in a day by one person from his fields by the aid of the "bug catcher" which has been devised to serve in the present emergency.

Remedies.—The efforts made to arrest the increase and ravages of this pest have been these: Hand-picking the beetles, or shaking them into vessels with water floated with kerosene; collecting the egg clusters; spraying with Paris green or London purple in water; dusting by hand with Paris green and lime; collecting the beetles with the "bug catcher."

The hand-picking and jarring has proved quite effective where small fields, say of an acre or less, have been treated in this manner. With larger ones it would be virtually impracticable. Perhaps the best—the tallest and most uniform and less injured—field that I saw was a half acre to which the owner and his son had given time each day by this method of protection. Although not so informed, I suspect from the good condition of the leafage that lime had been applied to kill the larvæ. The next most productive fields that came under my observation were those of Mr. Black, where the ground had been well enriched, carefully cultivated, sprayed at different times with a sprayer that

would cover six rows at once, and the "bug catcher" faithfully used. It is hardly necessary to state that this gentleman is not one of the "discouraged willow growers." Although his pay roll runs into thousands of dollars, there yet remain thousands on the profit side of the balance sheet.

It remains only to speak of the "bug catcher," so called. It was devised by one of the willow growers, and if without knowledge, as it is believed, of our Western "hopper-dozers," it certainly is an ingenious contrivance and the originator is entitled to considerable credit, for it is certainly producing, even in its present rude form, excellent results.

The bottom of the machine (described from recollection merely) is of a single piece of 2-inch plank, 20 inches broad and 4 feet long. The sides and ends are about 8 inches high. At the back are fastened two diverging arms extending forward nearly twice the length of the frame, and at their ends sufficiently far apart to receive two rows of willows as the horse drawing the machine passes between them. To these arms are fastened two cross pieces, and also a longitudinal arm, which may be adjusted in a slot so as to depress or elevate the arms according to the height of the willows at different periods of growth. A pair of bent arms like those of a plow are also attached at the rear for holding and guiding the machine. Its bottom is covered to a moderate depth with kerosene, the too free movement of which is controlled by several transverse slats, forming compartments. A series of slats arranged in pairs like a gable roof, with space between pairs to permit the beetles to fall into the kerosene, are fastened in a frame, which may be lifted out whenever the accumulated beetles require removal. The slats prevent the willows from coming in contact with the kerosene as they are pressed downward by the arms.

As the machine is drawn forward the willows entering the ends of the arms are brought nearer together in such a manner that before they are released from beneath the arms the beetles upon them are shaken upon the slats and drop into the kerosene.

A large proportion of the beetles is gathered and killed by this method. It is found, however, as the beetles drop to the ground at a moderate alarm, that the passage of the horse between the rows dislodges many of them. To obviate this machines have been made which are propelled by hand, having a wheel in front, after the manner of a wheelbarrow. Their use, however, has been found quite laborious, but there seems to be no good reason why they may not be made much less cumbersome.

Mr. Marlatt, referring to the extreme strength of the arsenate of lead used by him against the elm leaf-beetle, commented on by Dr. Lintner, said that it was not at all necessary for the destruction of the beetles or larvæ, but was employed merely to make the destruction prompt and doubly sure, on account of the peculiar conditions and the necessity

of preserving, if possible, the foliage of the trees from any injury whatever. A much weaker mixture would be almost, if not quite, as satisfactory.

Dr. Lintner said he had found 3 pounds of arsenate of lead in 150 gallons of water in his experiments to be about the equivalent of 1 pound Paris green in the same amount of water.

Mr. Webster read a paper on the probable origin of the genus Diabrotica. This paper, being somewhat technical in character, has been withdrawn by Mr. Webster for publication elsewhere.

The following paper by Mr. Hopkins was read, in his absence, by Mr. Southwick:

ON THE STUDY OF FOREST-TREE INSECTS.

By A. D. Hopkins, *Morgantown, W. Va.*

The study of the insects affecting forest growth, from an economic standpoint, is in many respects a unique branch of economic entomology, which should in our opinion be designated by the term "forestry entomology."

The importance of advancement of knowledge in this particular branch of science may be inferred from some references to the character of insect injuries to forest growth; to estimates of the amount of damage and the annual pecuniary loss occasioned by such injuries; to the limited knowledge of this class of insects, and to the possibilities of preventing a large per cent of the loss by the adoption of simple, practical methods of combating the pests.

CHARACTER OF INJURIES.

The injuries to forest growth may be separated into two classes, those affecting the living plants and those affecting the dead or dying plants. Of the former we have injuries to the foliage by leaf-eating, leaf-mining, sap-sucking, and gall-making insects; to the twigs and branches by sap-sucking, twig-mining, bark- and wood-boring insects; to the trunk by bark- and wood-boring, and to the roots by wood-boring, bark-boring, and sap-sucking species; the effect of the injuries thus caused upon the living plant being either destructive or detrimental to its growth or usefulness.

The injuries of a destructive character are those caused by insects which occur in sufficient numbers and make their attack in such a manner as to destroy or weaken the vitality of the tree sufficient to be the primary cause of its death.

The injuries of a detrimental character are those which are detrimental to the health, perfect growth, or future usefulness of the tree or its product, but does not cause its death.

Of the injuries affecting the dying and dead trees we find, as among those affecting the living, some which are of a destructive character,

while others are simply detrimental. The destructive injuries are those caused by wood-boring insects, which render the wood worthless for any practical use to man. The detrimental injuries are those which produce defects in the wood and hasten the decay of the affected parts.

CHARACTER AND EXTENT OF DAMAGE TO FORESTS BY INSECTS.

Few persons who have not given considerable thought to the subject realize the serious character of insect depredations upon our forests and forest products. This is evident from the fact that the subject is seldom discussed at the meetings of forestry associations and is rarely referred to by writers upon forestry economy in this country.

If we were to assert as our belief that the annual damage and loss occasioned by insects to owners of forest and forest products in the United States was greater than that caused to the same by fire, few persons, if any, would believe that it could be possible. Yet, when we come to consider the varied losses resulting from insect depredation, both in a destructive and detrimental manner and in the general influence of their work upon the forest economy of the country, we believe that such an assertion would not be far from correct.

The pine and spruce killed by bark-beetles over vast areas in New England and in the Southern States within the last few years has caused an enormous loss of valuable timber; yet this is only a small portion of the damage to timber by insects. That caused in oak by the timber worms (*Lymexylon sericeum* and *Eupsalis minuta*), the Columbian timber beetle (*Corthylus columbianus*), and the carpenter moths of the family Cossidæ, to the chestnut by the chestnut timber worm (*Lymexylon sericeum*), and to the tulip and other kinds of timber by the Columbian timber beetle, all of which attack living trees, will equal that caused by many forest conflagrations. Then when we come to consider the damage to the wood of dying, dead, and felled timber, and the work of destruction only begun by fire and completed by wood-boring species, it appears to us that the damage caused by insects is at least equal to that caused by fire.

There is also another feature of the question, and that is in reference to the effect of the detrimental and destructive ravages of forest insects upon the forestry economy of the country. Owing to the large amount of timber destroyed and rendered defective by insects, it is necessary for the manufacturers to cut over a larger area than would otherwise be necessary in order to supply the demand for the best grades of lumber and other timber products. According to a statement by Hon. J. Sterling Morton at the last meeting of the American Association of Agricultural Colleges and Experiment Stations, the area cut over every day in this country to supply the demand for forest products is 30,000 acres. From our observation in the lumber regions of West Virginia it would indicate that at least 10 per cent less timber might be cut each year for this purpose were it not for the detrimental ravages of insects

upon the standing and felled timber. Therefore, in this item alone the annual loss to the country and to the manufacturers is enormous, for it must be remembered that a large per cent of the defective lumber is manufactured and disposed of at a loss to the manufacturer, and is often the cause of serious loss to the consumer.

No accurate estimates of the pecuniary losses caused by forest insects can be made. Yet with the knowledge gained on the subject from recent investigations of the ravages of forest-tree insects, from correspondence with lumber manufacturers upon the subject, and reference to the statistics of forest products, we feel justified in presenting some figures which will at least indicate the extent of the loss.

We would estimate the loss caused by bark-beetles of the family Scolytidæ, which have caused the death of pine and spruce trees over vast areas within the last ten years, at an average of $5,000,000 per year; by bark and timber beetles of the Scolytidæ family, causing defective wood in felled timber, $1,000,000, and by the same in timber injured by fires and other causes, $1,000,000; by the Columbian timber beetle to standing and living timbers, an average of $1,000,000 per year; by the timber worms and the carpenter worms to the different species of oak, an average of $2,000,000 per year; to chestnut timber by the chestnut timber worm, which is rendering one of the most valuable woods almost worthless, an average of $1,000,000; by wood-borers of the family Cerambycidæ to standing timber injured by fire, $2,000,000; to felled timber and saw-logs by the same kind of insect, $2,000,000; by other wood-infesting insects to standing and felled timber, $2,000,000; by foliage-infesting insects to living forest and shade trees, $3,000,000; by the white-pine weevil, plant-lice, scale insects, etc., to young forest growth, $1,000,000; by the powder-post beetles (Ptinidæ) to forest products, such as seasoned handles, spokes, hoop poles, building material, etc., $1,000,000, and by miscellaneous insects not included in the above estimates, $3,000,000—a total of $25,000,000 direct annual loss from insect ravages, which is without doubt a low estimate.

To the above could be added the loss to manufacturers in manufacturing and disposing of defective material, to consumers from the use of the same, and to the indirect losses to the country in the diminished forest area due to insect ravages; all of which, could it be estimated in dollars and cents, would doubtless equal at least 10 per cent of the total value of the annual forest products of wood material in this country, or about $100,000,000 annually.

WITH FURTHER KNOWLEDGE ON THE SUBJECT MUCH OF THE LOSS CAN BE PREVENTED.

Probably one of the principal reasons why the economic study of forest insects has been neglected in this country is the prevalent belief that few, if any, practical methods can be found to prevent loss from their injuries. It is true the methods used to prevent loss from the

attack of farm, garden, and fruit insects can not, as a rule, be successfully used against those affecting forest growth; neither can many of the successful European methods of combating forest insects be adopted in this country. But there are simple, practical methods known which, if better understood by forest owners and manufacturers of forest products and properly applied by them, would prevent the annual loss of many millions of dollars' worth of timber.

Some of the results recently obtained and facts determined in the investigations now in progress in West Virginia in reference to the proper time to fell timber to prevent detrimental injury by insects, the utilization of defective material to the best advantage, and the introduction of predaceous and parasitic insects to prevent the undue increase of destructive species lead us to believe that many of the more serious troubles can be easily controlled when we learn more of the habits of the insects and the various conditions, favorable and unfavorable, for their development.

ADDITIONAL KNOWLEDGE AND MORE SPECIAL, ORIGINAL WORK NECESSARY.

Further original research and additional published knowledge are sadly needed in this branch of economic entomology. As compared with the knowledge of insects affecting other economic plants, scarcely anything is known of the life history and habits of even our commonest forest-tree insects. Consequently, the field for original work in forestry entomology is a broad one, rich in interesting material as well as in possibilities of important discoveries.

One of the most important aids toward advancement would be, in our opinion, carefully prepared monographs of the insects known to infest the different economic forest trees, on a similar plan to that adopted by Professor Forbes in his recently issued part of A Monograph of Insects Injurious to Indian Corn.

Previous to the undertaking of work of this kind, however, further knowledge is necessary in reference to the food habits of the insects found upon or within the different host plants, and whether they are destructive, detrimental, beneficial, or neutral in their economic relations to the host. This important information can be best and most reliably supplied by specialists who are studying the different families of insects, and by those who will make a study of the food habits and life history of certain classes of insects which infest forest growth, such as foliage-infesting, bark-infesting, and wood-infesting insects, etc., as special lines of research.

If specialists in these various lines will keep in mind the importance of noting the host relations of the species they collect or observe on forest growth, and will publish the knowledge thus obtained, together with lists of species taken on the various economic forest trees, they will contribute valuable service to the country in the rapid advancement of forestry entomology.

Mr. Smith said he was interested in the estimate of injury given by Mr. Hopkins, but was inclined to believe that it had been too strongly drawn, because slight and comparatively insignificant cases had been included in the estimates.

Mr. Webster read the following paper:

THE IMPORTATION AND REPRESSION OF DESTRUCTIVE INSECTS.

By F. M. Webster, *Wooster, Ohio.*

In the year 1795 my topic would have sounded remarkably visionary and illogical; not that it was not known that destructive insects were being brought into this country from England and Europe, but that there should be any united action to prevent such importations, or to suppress them after being introduced, would have sounded unreasonable and impractical. But, come to think of it, can we name a single imported insect that has been repressed, or, in fact, has been seriously impeded in its diffusion over the country, by any systematic obstacles placed in its way by the action of man? Is it not nearer the truth to say that we have, as a people, assisted this sort of immigrants, both in reaching this country and in getting inland as fast as possible after they had landed? Our entomologists have increased in numbers and efficiency to deal with these pests, but I do not know of a single one that we have prevented from coming to this country or stamped out after it had reached here.* That we have and are saving the country millions of dollars annually by our advice and experiments I freely admit, but that is only a temporary relief, and by no means a protection against future depredations and losses. Now, there must be something the matter somewhere, and if not with the entomologists, as I feel that it certainly is not, then wherein lies the obstacle? Entomologists do not make the laws, nor are we always able to get those properly enforced that we do have; but that does not settle the problem. For my own part, I have very little faith in State laws, even if they could be enacted, and have often asked myself the question whether or not it was possible for a republican government, composed of minor governments, possibly, as in our case, numbering nearly half a hundred, to protect its people from the immense losses occasioned yearly by destructive insects whose place of nativity is known to be thousands of miles away and across wide stretches of ocean which they could never have crossed unaided.

At present we seem unable to deal with the problem intelligently and practically, even within our own borders. We can not, as a people, protect ourselves from each other, much less from countries who very naturally have less regard for us than we have for ourselves. It was with such feelings that I watched the diffusion of the San Jose scale,

* See appended note at the end of this paper.

even after it had been located. Here was a simple problem in national economic entomology, and the question appeared to me to be composed of two propositions, viz, Could we do anything with it? and if so, what would be the importance of the entomologist in the transaction? We have been steadily gaining strength during the last quarter of a century, and I was just a little desirous of seeing how powerful we were getting to be, how much we could do to stop the spread of this pest, as well as to effect its extermination where it had already gained a foothold. True, we had no laws to sustain us; but if we could but show the necessity for them we would have accomplished much, for, while the San Jose scale is the latest importation, it by no means follows that it will be the last. It is all right to study the biology of the insect, and this is really the first step to be taken; but the duty of the economic entomologist does not stop there by any means. The man who has been unfortunate enough to get the thing in his orchard wants to know all he can learn about it, but the one who is free of it would vastly more like to know how to keep free of it. Some of you are aware that I am not in the least in sympathy with the manner in which we have been dealing with this pest, or rather with those who have knowingly carelessly harbored it. I do not say this with a spirit of fault-finding or criticism, but rather with the idea of improving upon the policy. I fully submit that it is not right to knowingly wreck the business of any nurseryman who is willing to do everything in his power to prevent distributing such a pest with his stock; but it seems to me that we commit even a greater mistake and do a more unjust act when we say that such a pest is in a certain locality, thereby throwing the onus on both the innocent and the guilty. This appears to me to be the very worst sort of an injustice and places a premium on dishonesty. We should either give the name of the proprietor or else make no public statement whatever, giving him notice that any attempt to send out infested trees or plants will result in a prompt exposure and public condemnation.

If I were to say that a member of this association was a murderer, it would reflect on the honor of all of us, and would serve to protect the guilty one from justice, provided there were such a one among us. Hereafter when we have to quarantine, let it be against individuals or firms and not against States or portions of States in which the innocent outnumber the guilty. We must use harsh and severe measures where such are necessary in order to be just to the deserving, but we have no right to make these deserving ones a partner in dishonesty with the unworthy and disreputable. To do this is but to place ourselves in a position where we are sure to be imposed upon by the latter and secure the merited distrust of the former. The people are coming to place some of their interests in our keeping, and if we would hold on to that confidence we must deal justly but firmly with those who threaten such interests, with the sole aim of profiting thereby. Even

if entomologists were clothed with the right to enter into an agreement with nurserymen to keep the presence of a dangerous pest a secret from the public, which I strongly question, it is poor policy to do so. For a public servant to make private arrangements with those harboring public enemies is, generally speaking, a risky business and not usually conducive to elevation in the estimation of those whose esteem we can not well afford to ignore. There should be a discrimination between the deserving and the undeserving, but it should be extended and not promised, and even then with the understanding that it was entirely in the way of official assistance. If we follow the proper course, so as to merit the confidence of the people, the latter will be perfectly satisfied with the information that infested nurseries are under strict surveillance, and nothing infected will be allowed to go out; but let there be a few more revelations of the actions of some of these, such as we have seen within the last year, and people will naturally begin to speculate as to whom we are assisting and whose interests we are protecting.

I mention these things because I believe we can improve upon the policy that some of us have been following, largely by force of circumstances. What I would urge is this: First, a uniform policy to be followed as closely as our surroundings render possible by all of us; second, on the information of an infested nursery coming to us the proprietors are to be informed that no infested stock is to be sent out, and that they are to promptly go to work to stamp out the pest, and that any attempt to evade these rules will result in a prompt exposure. If it is known that their trade will not suffer if they choose to purchase their stock from uninfested localities until they have destroyed the pest on their own, most men will see at once that it is the least expensive way out of the trouble. I am satisfied that there is a method of procedure that will work the least hardship to the deserving, yet will compel the stubborn to keep infection confined to their own premises and stamp it out there as soon as possible. I believe that we hold the balance of power, so to speak, and need not barter our influence, but hold it to be sought for by those who wish to escape with the least trouble and loss. If we are but just in our actions there will be no trouble about the better class of nurserymen siding with us, and we shall have no difficulty in indicating the dividing line that separates the honorable from the dishonorable, and it will avail nothing for a belligerent firm to close their grounds and books against inspection and then demand our proof of infection. The very lack of proof of noninfection will be sufficient to fasten suspicion upon them.

I have noticed that the services of entomologists have been quite in demand during the last year by nurserymen who were free of the San Jose scale, and the statements of such entomologists were used in the advertisements of these firms; and I think the influence of Dr. Lintner and myself has been felt by at least two nursery firms when it came to the question as to whether they could continue to impose on the public

or not. Now, while, as I stated, we have no laws to sustain us, we have a strong public sentiment in our favor, quite sufficient to influence the honorable to favor our plans, and the others we can whip into line, so to speak, by working on their interests. While we have not come out of this contest just in the shape that I wish we had, we have certainly placed our profession on a better footing and shown that we have a power to do for right and justice; that we can help the deserving and at the same time deal firmly and judiciously with the undeserving and disreputable; and so long as we are faithful to our trust we shall be able not only to hold our influence but greatly increase the same.

I confidently look for considerable aid from nurserymen themselves in the matter of preventing the distributing of orchard pests. The most pushing and energetic are beginning to see that it will pay to spray their trees year after year in the nursery row with both insecticides and fungicides; that by so doing they will get a better growth and consequently a larger number of first-class trees that will bring a better return for use of their land and labor. Now, these are not likely to be so blind as not to see that to be able to warrant their stock free from insect and fungus enemies will give them a prestige, and they will thus guarantee every bundle of stock that is shipped from their grounds. When we reach this stage of advancement it will be a small matter to get a United States law that will make this a condition of acceptance for transportation by the railway and express companies.

In the past our advice and cautions have been more or less ignored, but I think if a nurseryman were about to import trees or bring them from California he would think to consult the United States entomologist in regard to the risk he would run with respect to injurious insects. And there is little doubt that there will be much more caution exercised in future than there has been in the past, and the next new thing we get we shall be better prepared to exert our power and influence than we were in this case. I am satisfied that the San Jose scale can be stamped out where it has been introduced, at least between the Rocky and Alleghany mountains. East of this area it will have to be exterminated or else many nurseries will be compelled to suspend business for lack of customers, and they are not going to do this in the near future. We have done well this time, but we will do better in the future.

NOTE.—The fluted scale of the orange (*Icerya purchasi*), though it has been subjugated in California, at a saving of thousands, if, indeed, not millions, of dollars (and the importation of the natural enemies whereby this was accomplished was the greatest achievement ever attained in practical entomology), has yet to be exterminated. So of the gypsy moth (*Ocneria dispar*), introduced into Massachusetts by a lamentable piece of carelessness on the part of an entomologist many years ago, while it has been overcome in some localities, has not been extermi-

nated. I am free to confess that up to the time of presenting this paper I had very serious doubts as to the possibility of this ever being done; not because of any fault or neglect among those intrusted with the work, but because it appeared to me that they had attempted an impossibility. I have since spent a day in examining the work in all of its details, and believe that I saw not only what had been done but also what yet remained to be accomplished; and that, too, with unprejudiced eyes and mind, and in company with one who clearly had no other motive than to show me every feature precisely as it existed, without magnifying, minifying, or concealing anything. I now feel confident that the question of the extermination of this pest in Massachusetts is simply one dependent upon the support in future given those in charge of the work; that with proper support financially this pest will be absolutely wiped out of existence in America, and that the achievement will be the greatest yet attained, and one of which we shall all feel proud, while it will redound to the credit of economic entomology all over the civilized world.—F. M. W.

Mr. Fernald asked if anyone was aware of willful and malicious importations of injurious insects from Europe, referring in this connection to the report of the possible transportation of certain American insect pests in the opposite direction. He was himself aware of no such cases.

Mr. Smith said the only case known to him was the importation of the Ailanthus silkworm.

Mr. Howard said a report had been made that the hop louse had been introduced into the States of Washington and Oregon from New York hop fields by parties interested in the industry in New York, but he placed no faith in the story.

Mr. Sirrine, referring to Mr. Webster's communication, said that he had found about the 1st of July instances of the purchase of apple trees badly infested with living San Jose scale, which trees had supposedly been effectually treated before being sold and sent out.

Mr. Smith said that he was aware that these trees had been treated with gas during the winter, and described the methods which had been followed. In the examination made by himself he had found no living scales, but undoubtedly some living specimens had been left, and probably from these the trees had become restocked. He pointed out the necessity of examining every scale before it was possible safely to pronounce stock immune, and therefore the impracticability of giving any such indorsement to nurseries.

Mr. Riley emphasized the extreme difficulty and great liability to error on the part of entomologists should they follow the plan of pronouncing any particular nursery free from scale. In some cases circumstances may warrant such an indorsement, especially if there be

reason to suppose that the insect in question is recently introduced and therefore confined to a restricted area or single point of infestation, as seemed, indeed, to be the case in the first discovery of the San Jose scale in the East. In such cases it may not be necessary to give publicity to the point of infestation if proper measures are being taken to suppress the insect. It was on this basis that he acted in the case of the San Jose scale; but when an insect is known to be widely disseminated a full public statement of the extent of the infested locality is desirable.

Mr. Smith agreed with Mr. Riley as to the difficulty of pronouncing any nursery untainted, and had decided for himself not to give clean bills of health to any nurseries in future.

Mr. Southwick read a paper entitled "Economic entomological work in the parks of New York City." *

Mr. Howard, referring to Mr. Southwick's remark that his men were all too old to climb trees, said that the gypsy moth commission put their men through a civil service examination as to their ability to climb trees and look down from heights without dizziness. He asked if accurate information as to the distribution of *Megastizus speciosus* could be given by anyone present.

Mr. Smith said that this wasp was abundant at New Brunswick the present year.

Mr. Webster presented the following communication:

INSECTS OF THE YEAR IN OHIO.

By F. M. Webster, *Wooster, Ohio.*

The present year has been an extraordinary one in Ohio from an entomological point of view. So far, since the opening of spring, one outbreak has followed another in rapid succession, and between the big guns, like cutworms, webworms, Hessian fly, and chinch bugs, have come the usual number of novelties, which, however disgusting and perplexing they may be to the tiller of the soil, are to the economic entomologist zephyrs that break the dead, stifling calm of everyday life. After one has spent nearly the whole day replying to a mass of correspondence that does not cover beyond a half dozen of our most common species, and has written the same recommendations a score or more of times, he feels almost devoutly thankful to the man or woman who sends in a new insect with a careful statement in regard to its good or bad habits.

Sometimes, while in a particularly cheerful frame of mind, we think that we have gained a pretty full knowledge of an insect and can tell with reasonable certainty what its condition will be a few months in advance. The chances are, however, that ere those months have passed we have about decided that were we to live to the age of Methuselah

* Not furnished for publication.

and to be reasonably industrious we would still be considerably in the dark. Last autumn, as the ground was rather dry during the season of wheat sowing, I thought surely that this year would show a marked decrease in injury by the Hessian fly, for the reason that seed germinated very slowly and the plants did not appear above ground, except in damp places, until very late.

Fortunately, I did not make any public statements to this effect, and luckily so, for this pest has not been so destructive in Ohio during the last thirty-five years as it has been the present summer, and only a comparatively few fields escaped injury, at least so far as personal observation revealed, and these were either among the later sown or on low, rich ground, where drought and lack of fertility did not emphasize the work of the fly. Last fall there was nothing to indicate this outbreak, and I believe the chief element in causing the unusual abundance of the spring brood was the meteorological conditions during April and May, which, if we fully understood their influence, would prove to have been unfavorable to the natural enemies and favorable to the development of the pest itself. Whatever the cause may have been, we have a further illustration of the frightful risk one runs in attempting to foretell the future in regard to injurious insects, for by so doing we only pit ourselves against subtle influences that we do not as yet begin to understand. Professor Lugger recently asked me how the Hessian fly could inhabit a country where there was neither grain nor grass growing for six months of the year. I replied by asking him the same question, and myself the one that has presented itself to me again and again, viz, Must it not necessarily be single-brooded in the North?

In May reports came in myriads regarding an outbreak of cutworms that seemed to cover the southern half of the State, gradually disappearing toward the northern portion. A very conspicuous feature of the larvæ of this species, *Feltia herilis*, as determined by Mr. Howard, was its nomadic nature, great numbers moving across highways and pathways almost as does the true army worm, excepting that in this case the worms did not move so regularly forward, but were more inclined to run about, hither and yon, as if with no objective point in view. In very many cases these larvæ were spoken of as the army worm, and the most of my correspondents considered them as such, at least for a time.

Now, while all of this was going on in the southern part of the State, the northern farmer was practically unmolested and only knew of his brother farmers' misfortune as he read of it in the papers. But in the meanwhile an enemy as devastating in its effects and even less easily managed was lurking in the grass lands, in the shape of several species of webworms, larvæ of species of Crambus. These webworms were more abundant over the northern portion of the State, gradually decreasing to the southward, overlapping, as it were, *Feltia herilis*, and

disappearing as this became more abundant and destructive. Fields of young corn and oats that had germinated nicely and gave promise of a bountiful crop were within the space of a few days swept out of existence, leaving the ground as devoid of growing grain as if none had been planted. Even meadows did not escape, and in many places these were left as bare and brown as in December. Of course the trouble was confined to such lands as had been devoted to grass the preceding year or on which the grass had not been subdued by the cultivation of the previous crop, as, for illustration, a field of oats was nearly entirely destroyed over an area that had produced wheat the previous season. All sod lands did not suffer alike, an occasional field escaping almost entirely. On the Experiment Station grounds one field had been devoted to grass for two years and another for four, both being alike as to soil and both sloping to the northward. The first-mentioned field was plowed in spring and sown with oats, but nearly every plant over the whole field was eaten off and killed by webworms. The second field was partly spring-plowed and partly fall-plowed, but no perceptible difference in point of attack was noted and the oats here were not destroyed.

A field was broken in May, but the owner saw such numbers of the worms that he became alarmed and delayed the planting of his corn for two or three weeks. Some time after the field had been plowed I had an opportunity to examine it, and found that the worms were leaving the field, pushing outward along two sides and taking every blade of grass as they went, leaving only the yarrow (*Achillæa millefolium*) that grew among the grass. The attack was made among the dead and decaying grass of last year, just above the surface of the ground. In fields of corn or oats I noted that along the margins of the fields, where the horses had tramped when turning, the injury was at first very slight, though later on the worms seemed to spread out over this and devour the plants here also. Very late fall or winter plowing appeared ineffective, though there are some facts leading to the possibility of early spring plowing being to a limited extent beneficial. Summer fallow was effective, though in one field where much injury was done the worms were traced to small patches of grass growing about old stumps. Of one thing this outbreak has convinced me, and that is that the farmers of the Mississippi Valley at least must change their method of treating sod lands—that is, lands that are broken up from meadow or pasture and planted. Just what to do I am at my wits' end to suggest, unless it be to summer fallow. So far as I have been able to learn from limited collections made, the species of Crambus most abundant between May 29 and June 17 were *Crambus interminellus* and *C. laqueatellus*, while *C. mutabilis** was secured in more limited numbers. On May 29 *C. interminellus* outnumbered *C. laqueatellus* in the proportion of 17 to 3, but on June 3 the latter outnumbered the former 14 to 2. Having

* Determined by Professors Fernald and Smith.

no assistant and being absent from home much of the time prevented my rearing anything.

We had fairly gotten over this irruption, so to speak, by the middle of June, when I went to the section where chinch bugs (*Blissus leucopterus*) had occurred last year, having been informed that a field of corn had been destroyed by this pest. The trouble, however, turned out to be the work of the broad-striped flea-beetle (*Systena taeniata*), and I could see or learn of no indication of an outbreak of the pest in the section of country where they were the most numerous last fall. This was the last week of June. Within a week an occasional letter came complaining of the appearance of chinch bugs, but these came from central Ohio, considerably to the east of the area of occurrence in even small numbers last year, and little attention was paid to the matter for two or three days. But complaints continued to pour in, some of them accompanied by specimens, thus leaving no doubt as to the validity of the statements. A trip through the central portion of the State about the 10th of July left no doubts as to the truth of the complaints nor of the extent of the ravages of this pest. It had clearly been breeding unnoticed in the wheat fields, and when such were harvested this pest migrated to the cornfields adjoining, as is its wont. As one of my correspondents expressed himself, it was like a clap of thunder out of a clear sky. Thousands of farmers within the three worst infested counties—Franklin, Delaware, and Union—had never seen a chinch bug, and many had sent specimens to me asking what they were. I may here say that in the above-mentioned counties I saw the bugs as abundant as I ever did in Illinois or western Indiana during the years of their greatest abundance. Farmers were struck with consternation and appealed to the station, the State University, and even to Governor McKinley for aid in destroying the scourge. The Department of Agriculture at Washington, Professor Forbes, State entomologist of Illinois, and Professor Snow, of Kansas, were applied to for muscardine fungus with which to destroy the bugs, there seeming to be an exaggerated idea that if some of this or infected bugs were placed in a field it would sweep off the pest instanter and stop its spread then and there—an idea that certainly did not originate with anything that I had either stated or written.

It was of no avail to attempt to explain that the fungus *Sporotrichum globuliferum*, while it would work quite rapidly in wet weather, would be almost wholly ineffectual in the midst of the drought that was prevailing at that time. I had received eight packages of the muscardine fungus from Professor Forbes, and at once began infecting chinch bugs to send out to such farmers as would apply for it, warning them, however, that it could not be relied upon to stop the spread of the pest quickly, but that the true object in distributing it was to ward off another visitation next season, if possible, in case the weather was favorable to the development of the pest. We have distributed something

over 600 packages of infected material, the greater portion of it going to within a radius of 40 miles of Columbus, though 37 counties have received more or less. (For distribution of chinch bug in Ohio in 1895 see map, fig. 1.) It has established itself in the fields in several localities, and we shall certainly derive all benefit possible from its introduction. For infecting boxes I at first used those recommended by Professor Forbes, but later abandoned them, or rather had them remodeled,

FIG. 1.—Map of Ohio showing district infested by chinch bug in 1894 (from drawing furnished by Mr. Webster.)

and had additional ones made, 12 inches longer and 2 inches higher. Instead of chalking the sides to prevent the bugs from escaping, we had a strip three-fourths inch wide fastened around the inside of the box, 2 inches from the top. This formed a narrow shelf, which we kept filled with sifted road dust, piling upon it all that would remain, thus forming a steep barrier up which the bugs could not crawl, at

least until the abruptness of the ascent had been greatly diminished.* Then, instead of corn or grain cut off and laid in the box, we used growing millet taken direct from the field and cut off to about three inches in height and set in the bottom of the box as thickly as possible. I found that by this means we kept more of the bugs on or about the plants, avoided mold to a greater extent, and also the trouble of continually rechalking the sides of the boxes, though, of course, in time the bugs would roll down a portion of the dust barrier and climb over it. I may here state that on August 6 I received a large consignment of live chinch bugs to be used in our infecting boxes. These were from Northup, Gallia County, in the extreme southern part of the State, and the greater part of them were very young, not yet having thrown off the red color, and there were thousands of them, showing that the second brood of young were present in great numbers.

In March I received the plum scale, whatever the name of this species may finally prove to be, from several localities in Ohio, and in one case in such abundance as to cause alarm. The pest was even more abundant on the twigs than the dangerous cases indicated by Mr. Slingerland in his bulletin treating of this pest. Promptly on receipt of the specimens the locality was visited and many trees found to be very badly infested. Spraying with kerosene emulsion was recommended. This was done, but later examinations of a large number of scales by myself revealed the fact that not over 50 per cent had been killed, thus leaving the pest uncomfortably near the danger line in point of numbers, and later plenty of the young were found moving about during the middle of the day. From what I was told at the meeting of the National Association of Nurserymen at Indianapolis in June, by several New York fruit growers, it was clear that unless some unforeseen aid came we would have trouble. On July 3 I visited two of the worst infested orchards in Ottawa County, but failed to discover any young, though, according to Mr. Slingerland's studies, these should be present about that date. July 25 these same orchards were again visited, and with the closest and most patient search I was only able to find an occasional young, either on the twigs or foliage. Now, all of this relates to two plum orchards that were badly infested with this plum scale last year, and the living young were very numerous this spring, even after having been treated with kerosene emulsion. I secured some young trees from the same locality and transplanted them into the insectary, stocking them with scale larvæ brought from one of the infested orchards. Soon after the young had established themselves on the young trees in the insectary there appeared from out of the old females that remained on the twigs brought from the orchard numbers of *Coccophagus flavoscutellum* Ashm., and these began to oviposit in the bodies of the young, and continued to do so until it seemed that

* This idea originated with Mr. E. E. Bogue, who was my temporary assistant from July 16 to September 16, but not afterwards employed.

hardly one could escape, as has since proved to have been the case. I find this parasite abundant in the two orchards, while many of the old scales of last year that still remain on the trees are filled with holes through which the parasites have escaped. To this useful little parasite, then, I give credit for protecting the plum crop in at least two orchards. From this plum scale, received from Medina County, I have reared *Coccophagus lecanii* Fitch, *Eunotus viridus* Ashm., and *Pachyneuron altiscuta* How., while from other material sent me from Harrison County I have reared *Aphycus pulvinariæ* How. Moreover, *Comys bicolor* How. has been found in the insectary under conditions that strongly point to its being also a parasite on this scale. These parasites were determined by Mr. Howard.

Colaspis brunnea Fab. has been sent me, accused of destroying growing potatoes by eating the tops; also of destroying beans and corn.

Owing to the depredations of webworms among oats last spring, some fields were resown, which has delayed ripening. Up to August 7 I had received *Siphonophora avenæ*, it being reported as attached to the oat heads in immense numbers. The same phenomenon has also been reported from Pennsylvania, and I have observed it to a limited extent on the station farm at Wooster, Ohio. This in part covers a period over which I have for the last eight years been trying in vain to follow this species.

Brachymena annulata is either increasing rapidly or else I notice it more closely, and I am rather fearful of trouble with the ill-odored pest sooner or later. I find the eggs are hatching in northern Ohio all through the month of July.

The clover leaf-weevil (*Phytonomus punctatus*), though it threatened trouble last spring, was held back from doing any serious injury by the fungus disease, *Entomophthora sphærosperma*, and though the pest has this year spread over the remaining area in the central portion of the State not heretofore occupied by it, yet I do not consider it a dangerous insect, because there is little danger of enough larvæ escaping this deadly enemy to do much injury.

The harlequin cabbage bug (*Murgantia histrionica*) has at last gained a foothold north of the Ohio River. It has been twice reported from extreme southern Ohio (Scioto and Gallia counties) as having committed extensive depredations among cabbage last year, and is also very abundant this year and rapidly spreading. This is the first record of serious depredations north of the Ohio, so far as I am aware.

I have this season had an opportunity to observe the work of *Ceuthorhynchus rapæ* Gyll. in young cabbage plants. This species is not yet included in Mr. Henshaw's lists of the Coleoptera of North America north of Mexico, though it was reared from cabbage by Miss Murtfeldt in 1888 at Kirkwood, Mo. I found the larvæ, sometimes two or three in a stalk, but reared only a single adult, and did not secure the pupa. The pupa of a medium-sized hymenopterous parasite was found in one of the burrows of the larva, but this also failed to develop to the adult.

The attack of this not yet common curculio occurred near Dayton, Ohio, in a small bed of young cabbage plants that had been started for late planting. The ground was a low, marshy field, bordered by a pasture of native grasses and other indigenous vegetation, in which the pest doubtless breeds. The adult appeared July 18, at which time larvæ were still to be found in the plants.

Monarthrum fasciatum Say was sent me in May from Noble County, where it was working with *Scolytus rugulosus* on peach. The Monarthrum seemed to bore directly into the wood to a considerable distance and then work as directly around the tree, so that its burrow constituted a complete ring, and this, too, in the green wood. The Scolytus was exceedingly abundant last year, and there was much complaint of its ravages, superinduced, I presume, by the unusually dry weather, which really weakened the trees without its being noticeable.

The woolly aphis (*Schizoneura lanigera*) is certainly becoming more abundant and working more and more injury to young nursery stock. It has come to me more frequently during the last year than ever before, both from Ohio and Indiana. I have of late been calling attention to the fact that Australian nurserymen use Northern Spy and Majestine stock upon which to top work other varieties, claiming that these two are proof against this pest, which is there termed the American blight.

The time available for the reading of papers having expired, the following three papers the authors of which were absent, were ordered read by title and referred to the committee on publications. (That committee, consisting of the president and secretary, has decided to include them in the proceedings.)

ON THE NATURAL CONDITIONS WHICH AFFECT THE DISTRIBUTION AND ABUNDANCE OF COCCIDÆ.

By T. D. A. Cockerell, *Las Cruces, N. Mex.*

While the danger to horticultural interests from the general spread of Coccidæ is sufficiently patent, any one who has given much attention to these insects must have been struck by the difficulty of predicting how a particular species will act in any given case.

For example, *Aspidiotus aurantii* is very well known as a pest of citrus trees in California and the eastern Mediterranean region. One would have predicted that its introduction into Jamaica—a great orange country—would have been disastrous; but as a matter of fact it is already not rare in that island, where it is never observed on citrus.

Its place on the citrus trees is taken by the similar-looking but structurally quite distinct *A. articulatus*.

Again, *Parlatoria pergandei* is known as a citrus scale in the southern United States. In Jamaica and Antigua it occurs, but only on Croton, never on Citrus. But here comes in an important fact—the

West Indian *P. pergandei* differs a little from the type form in its scale, so that I have named it variety *crotonis*.*

In the Eastern States *Aspidiotus uvæ* occurs on Vitis; at Las Cruces, N. Mex., a slight variety, var. *coloratus*,† is found on Chilopsis, to which it is quite destructive, but never on Vitis.

Conchaspis angræci is a species observed in the West Indies only on cultivated orchids; in Mexico Professor Townsend has found a variety of it living on Hibiscus.‡

Numerous other examples might be cited in which marked differences in food habit coincide with varying degrees of apparent structural variations in the insects—ranging from inappreciable variations, as in the Jamaican *A. aurantii*, to differences sufficient to separate distinct species.

In the latter case we see no cause for surprise, but it is certainly worthy of our attention that certain slight varieties or indistinguishable colonies of individuals act as though they were distinct species. Ordinarily our species are founded on structural characters; but these are what I have called physiological species, easily distinguishable by their habits, but hardly or not at all in their structure. That they tend in the course of time to develop into ordinary species with distinct structural characters is of course more than probable. That they already in every case possess some structural peculiarities too subtle to be observed is not impossible or unlikely. In some instances, as noted, there is just enough of difference to permit the separation of a variety.

From an economic point of view the importance of these facts is manifest. Are we to suppose that the Jamaican *Aspidiotus aurantii*, so called, is really a physiological species distinct from Californian *aurantii?* If so, would California *aurantii*, if introduced into Jamaica, proceed to play havoc with the citrus trees? There is room for some experimental work here. Is it possible that *aurantii* can not exist on Jamaican citrus trees because of the abundance of other species, particularly *articulatus?*

We can understand why the Chilopsis *Aspidiotus* in New Mexico does not attack the grape-vines (which are there free from coccids), since there is a slight difference in the insect. But it is so slight that it would assuredly have escaped notice but for the accompanying physiological peculiarities.

Another instance is offered by the common large species of Pulvinaria found in this country. They are so much alike in structure that they all go, as a rule, under the name of *P. innumerabilis*. The osage orange form, *P. macluræ*, is, I am convinced, a distinct species; and probably a thorough study, with abundant material from all parts of the country, would reveal several physiological species or varieties. To sift

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* Ann. Mag. Nat. Hist., July, 1895, page 62.

† Psyche, 1893, page 571.

‡ Bull. Bot. Dept., Jamaica, May, 1895, page 101.

this matter to the bottom we must not merely study cabinet specimens, but make numerous observations and experiments upon the living creatures. It is a big task and will need many workers, but it is well worth the doing, both from the scientific and economic points of view.

The situation is simply this: There is a prevalent tendency for dominant types of Coccidæ to become multivorous or polyphagic, and when they have become so to any extent they are nearly always of serious economic importance. But there is the reverse tendency for polyphagic species to split up into monophagic races, varieties, and ultimately species. As they do so their economic importance usually decreases, and when it does not they are at any rate more easily dealt with. It is for us to ascertain in each case by close observation how far these processes of evolution have gone, and until we do so we can not rightly understand the situation before us.*

I can not refrain at this point from remarking on the utter inadequacy of the old-fashioned study of "good species" only, accompanied by a vast contempt for all species or otherwise which were not "good."

The new entomology will have to consider with equal care all phases of insect evolution, from the individual, through the mutation, form, variety, to species, good, bad, and indifferent. The old plan was excellent for collectors of insects, but for economic entomologists, at any rate, it will no longer do. In Coccidæ perhaps this is more obvious than in any other group.

Another notion that I think we shall have to give up is that these evolutional processes all take "ages." On the contrary, quite a number of cases are now on record in which the habits and even the structure of wild animals have changed within a few years. I need only remind you of the Porto Santo rabbits, the Virginia *Helix nemoralis*, and the *Amphidasys betularia* var. *doubledayaria* in England to show that characters which might be deemed specific have begun to appear within a few years under changed conditions of life. How many changes in habit only have occurred we may never know, for it is only in striking cases that they get recorded. But the whole literature of Coccidæ teems with records of species infesting in new localities plants they had never before attacked. In many instances, as, for example, that of *Orthezia insignis*, we can not tell what were the original food plants.

Among Coccidæ the rate of multiplication is prodigious, often probably more than a thousandfold in one generation, and the destruction correspondingly great, giving full play to certain kinds of natural selection—i. e., those which affect the "staying power" of the individuals. Among the many larvæ blown by the wind or carried by birds or insects and among the many falling victims to parasites it may be largely a matter of chance which shall survive. That is to say, the survival is not necessarily due to any peculiarity in the individual. But those which can live on an unwonted plant or can stand adverse conditions of weather survive by reason of inherent qualities in themselves.

*For a discussion of the theoretical considerations see Insect Life, vol. v, p. 117.

Thus, theoretically, it is not impossible that the severe frost which occurred in Florida may be followed by an extension of some Coccidæ northward, owing to the repeopling of the trees by a race derived from the exceptionally frost-proof individuals which survived. Under the former conditions these individuals had no special advantage and did not particularly multiply.

When a coccid abounds on a given tree, young larvæ will find their way to surrounding shrubs, trees, and herbs. Often they must entirely perish; sometimes, as one may see in Eulecanium, they survive in a stunted and distorted form; sometimes, again, they contrive to not only mature but multiply. In the course of time there may fall on an uncongenial food plant one or two individuals capable of surviving upon it, and these will give rise to a new colony, which from the very start differs in its average character from the parent colony, just as the pilgrims in the *Mayflower* gave rise to a colony in America differing in its average from the parent country, and, what is more, advantageously differing.

These things do not require ages: I am sure they are occurring constantly within the short period of our individual lives, and have only to be looked for to be seen. Herein is the explanation of certain flourishing colonies of coccids on plants not commonly infested by them; or, on the other hand, of the absence of such colonies where they might be expected. In Santa Fe, to cite a case of the latter sort, *Aspidiotus ancylus* scarcely at all leaves the box-elders to infest the closely adjacent fruit trees.

Not only is the spreading of Coccidæ from one species of tree to another thus irregular, but there is even irregularity in the attacks on different varieties of the same trees. It would be very interesting to obtain full statistics as to the varieties of fruit trees attacked by coccids and see how far they coincided in different localities. Mr. Barrett, of Las Cruces, N. Mex., gave me the following as his experience with *Aspidiotus perniciosus:*

Pears: Comparatively free; Flemish Beauty, not bad; Walker's Seedling, very bad; Bartlett, not very bad; Leconte, very bad; Duchess, very bad. Apples: Ben Davis, a good many scales; Loy, almost entirely free; Maiden Blush, pretty bad; Red June, hardly any scales. Plums: Wild Goose, least attacked; Lombard, very bad; Abundance, pretty bad; Japanese, pretty bad. Quinces: Not bad.

On wild plants it is very remarkable how the coccids occur in isolated colonies, even when the plants abound. The species on *Atriplex canescens* in the Mesilla Valley are six in number, but all occur only in isolated patches, though there is no apparent reason why they should not spread all over the acres occupied by the food plant. They have parasites, however, and I suppose they are driven from bush to bush, here and there almost annihilated, a few only surviving to found new colonies. This constant harassing might be expected to lead to the natural

selection of individuals able to escape the notice of the parasites and so modify the race. But such modification may be very slow; for example, the Prosopophora on the before-mentioned Atriplex is very little different from a Japanese species from which it must have parted company long ages ago. On the whole, selection by parasites is probably a less important factor in coccid evolution than one had been ready to assume.

In our ordinary accounts of coccid enemies we omit some factors which may possess importance. Mr. Newstead has lately given some interesting observations on the feeding of birds on coccids. Mr. Barrett, above cited, found that the San Jose scale disappeared from his Walker's Seedling pear trees, which were very badly infested, when *Bryobia pratensis* appeared upon the scene. I saw the trees with the Bryobia upon them, and no scale to speak of. Mr. Steel, also of Las Cruces, N. Mex., had some peach trees badly infested by San Jose scale. When I examined the trees this year there was no living scale, and the trees were swarming with a small ant, which Mr. Pergande determines as *Tapinoma anale*.* For two years these trees had borne no fruit; now they are fruiting.

These rough notes may serve to indicate some of the lines of work desirable in the future, if we are to understand our Coccidæ. No greater mistake could be made than to suppose that I or any other person can from cabinet specimens alone settle everything. We must have observations on the living insects.

HOW SHALL WE IMPROVE OUR COLLECTIONS?

By C. P. Gillette, *Fort Collins, Colo.*

A correctly determined collection of insects is about as important for the best entomological work as a good library. The writer, in receiving answers from various college and station entomologists in regard to their collections, has been surprised to find that there are so few really good collections and that there are so many institutions that have practically no collection of determined insects at all. This is not as it should be, and with a little effort of the right sort on the part of the entomologists in charge I believe it need not long be so.

Collections may be made in various ways. Some of the older institutions could well afford to purchase good collections, but few of us can depend upon any considerable sums of money for this purpose, and it is probably about as well that we can not. What I wish to urge at

* First described by Ernest André from a specimen collected by the present writer in Mexico in 1893. In Proc. Cal. Ac. Sci., May, 1894, page 163, Mr. Pergande considers it a variety of *T. pruinosum* Rog. and records it from California and Lower California. It is new to New Mexico.

this time is two methods of building up our collections that are inexpensive, require little time, and that will tend to bring the working entomologists into closer fellowship with one another.

An economic entomologist should be acquainted with the injurious and beneficial insects outside of his own little field of labor. I wonder how many of the stations or colleges there are that can not show a specimen of *Melanoplus spretus*, *Blissus leucopterus*, *Cecidomyia destructor*, *Aspidiotus perniciosus*, or even *Carpocapsa pomonella*, if asked by a visitor to do so. There are probably a number of institutions where not one of these common species can be found, and I have serious doubts if there is an agricultural college or experiment station in the country that can show all of them.

I have a list of over ninety species of insects that have been reported to me as being one of ten of the most injurious species in the different States, and I do not believe there are more than a half dozen institutions that can show one-quarter of these pests in their collections.

Entomologists in States where these insects are abundant could easily collect them in quantity, and then, by a system of exchange, every State could soon have a collection that would well represent the more economic species of the country. For example, A could send B a list of the species in any order or orders that he has for exchange, and B could return the list with those species checked that he desires, and at the same time inclose a list of what he can offer in return, with the understanding that they will exchange as many species as the one marks who marks least. For my own part I should be glad to exchange in all the orders in this way, and believe that all could enter into the work with profit.

The other plan I have to propose is quite different, but I believe could be entered into with equal profit, and especially by those who have small collections. There are entomologists in the various agricultural institutions, and others outside of them, who are doing special work in every order. Most, if not all, of these would undoubtedly be glad to receive undetermined material in quantity from any locality, with the privilege of retaining uniques and with the understanding that he should return to the sender a determined set of the duplicates.

In this way specialists would be greatly aided in working up their favorite groups, which will result in a blessing to entomological students in general. The person furnishing the specimens will gradually work up a collection the species in which will be determined by the best authorities, and at the same time will feel that the specimens that were retained by specialists are placed where they will do most good and that he has done something for the advancement of the science that he loves.

We have done a good deal of this kind of work at Fort Collins, and with very satisfactory results. Quite a number of species are lost to us in the hands of specialists until we can find duplicates, but that is where they belong. We have the records and our boxes are relieved of a great

mass of undetermined material that would be of no use to us or anybody else, and our determined collection, which is the only really valuable one, is greatly improved thereby.

At the Colorado Agricultural College we shall be glad to receive, on the above terms, from any person, material in Cynipidæ, Jassidæ, and Typhlocybidæ, and especially in the last-named family. Specimens may be sent in quantity unmounted and we will mount and return determined sets of duplicates.

How to collect rapidly.—As this is an important matter to consider in the making of a collection, let me tell how we proceed at Fort Collins. It may be a help to someone.

We use a net 15 inches in diameter, made of strong cheese cloth, or, better, thin muslin, which is stronger. Any material with coarser meshes than cheese cloth will not do, as the smaller insects will go through. With this net we sweep or beat low herbage for a few minutes, and then with a few sudden jerks of the net all the insects are sent into the corners, and these are quickly gathered up and put into a large cyanide bottle until the insects are quiet. Then the net is removed and the contents emptied into another bottle, a few of the more delicate insects being removed with forceps and put into a bottle by themselves. The operation is then repeated until the bottles are filled or we have no more time to devote to the work. On reaching the laboratory the bottles are emptied on a sheet of paper, and with a pair of forceps the insects are separated from the rubbish, the different orders being put in little piles by themselves. These are then mounted at once, or are stored for mounting at some future time. We store them, in perfect condition, in small wooden or pasteboard boxes, as follows: A thin layer of the insects is spread evenly over the bottom of the box and covered with a sheet of paper cut to fit. On this paper is written any notes we wish preserved upon the insects beneath it. The box may then be filled with cotton, so that when the cover is on the cotton will press gently on the insects below and keep them from tumbling about; or a very little cotton may be added and then a sheet of paper and another layer of insects, and then another sheet of paper, and the cotton on top of this. No matter how many layers of insects are put in a box, there should always be a sheet of paper on both sides of them to prevent their legs and antennæ from getting tangled in the cotton.

This method of collecting is specially to be preferred on long collecting trips and when one desires to collect rapidly without stopping to mount his specimens as he goes along. It is always best, when possible to do so, to collect from only one kind of plant at a time, and then keep these sweepings in different bottles and in separate layers in the boxes, properly labeled. Such a collection is worth fully twice what it would be if the food plants of the various species were not known.

If the specimens were separated into their proper groups when they were put into the boxes, these boxes may be sent directly to specialists for determination, if they will consent to receive them.

CARBON BISULPHIDE FOR CRAYFISH.

By Howard Evarts Weed, *Agricultural College, Miss.*

Crayfish sometimes do much injury to corn and other crops in land that contains considerable moisture through lack of proper drainage. I have seen fields where the crayfish holes were so numerous that they would average in number nearly nine to the square foot, and upon such land it would, of course, be impossible to raise any cultivated crop. Such fields are generally abandoned, and only broom sedge and a few of the coarser grasses will grow on land of this description. Crayfish are also numerous along the bottom and sides of open ditches. By their work along the levees of the Mississippi River they cause weak places in the embankment, through which the water gets a little start. Once let the water get started in this way and the hole is gradually washed larger and soon the embankment gives way and an overflow is the result.

Such being the damage caused by these pests, the question of how to destroy them becomes of no small importance, and perhaps some experiments of mine in this direction may be of interest. In the spring of 1893 I noticed that the bottom of a wide, open ditch near the Experiment Station building was lined with crayfish holes. Having doubts as to whether or not carbon bisulphide would kill the crayfish, I poured about an ounce of the liquid into each hole, closing the hole by pressing the dirt together with the foot as soon as the bisulphide was put in. A stick was placed by the side of the place where each hole had been, so as to enable me to tell if the same holes were reopened or if new ones were made. The ditch was examined every day for some time, but none of the holes were reopened, showing that the bisulphide had been effective. No new holes were made along the ditch for three weeks, and then only two, which were probably made by some newcomers.

I have on two occasions dug the crayfish out the day following a bisulphide treatment and found that they had been killed. Their holes may be anywhere from 1 to 15 or more feet deep. They dig deep enough to get water, and in wet weather or on low places the holes are not so deep as in dry weather or on high places. For two years past it has been a common practice with me to treat crayfish holes with carbon bisulphide, and in every case, with but one exception, the treatment has been successful.

The particulars of this exception are as follows: In September, 1893, a place on rather high but poorly drained land was graded and put in shape for a tennis court. The ground being somewhat sloping, about 3 feet of earth was taken from one end and added to the other end, in order to make it level. A few days after the court was fixed many crayfish holes were noticed, both upon the part where the dirt had been added and where it had been taken away. These holes were treated

in the usual manner with carbon bisulphide, fully expecting that this treatment would rid the tennis court of the crayfish. The next day, however, it was found that the holes had been reopened during the night and a second treatment was made, using fully double the amount of bisulphide. The result of the second treatment being the same as the first, daily treatments were made for over two weeks, in some cases nearly a pound of bisulphide being used to a hole. It was fully three months before the tennis court was free from crayfish holes, but whether the crayfish left the ground for a more favorable situation or were killed I am not prepared to say. Bisulphide from the same can was effective in other places, so that the failure was not due to the quality of the bisulphide used.

Were it not for this one case of the failure of carbon bisulphide to do effective work I would be prepared to recommend it for crayfish in all cases. The failure mentioned, however, was under somewhat unnatural conditions, and as I have used the bisulphide successfully over fifty times, with but this one case of failure, it may be said that carbon bisulphide is a nearly if not quite complete remedy for crayfish. On land where they are very numerous it will not always pay to treat them in the manner described, as the treatment would cost as much as the land, but in the garden and along the levees of the Mississippi River there is no question that the treatment would pay.

The paper entitled "Notes on Smerinthus cerysii Kirby," by F. L. Harvey, was withdrawn for publication elsewhere.

The following resolution relative to the gypsy moth commission, introduced by Mr. Howard, was brought up and received the unanimous indorsement of the association:

Resolved, That it is the sense of this association that the present gypsy moth commission is prosecuting its work in the most intelligent and praiseworthy manner, and that its hands should be upheld by the State authorities.

Mr. Lintner presented the following resolution, which also received the unanimous indorsement of the meeting:

Resolved, That this association has learned with deep regret of the intended discontinuance of Insect Life with the present number. In consideration of the unusual value of this publication, the eminent ability with which it has been conducted, the high appreciation in which it has been held by all of our entomologists and those in other countries, and the importance of the published investigations into the life history of insects, largely on their economic aspect, this association earnestly requests of the Department of Agriculture that the resumption of the publication of this invaluable publication may be directed at no distant day.

The matter of the publication of the proceedings was brought up by the president, and on motion of Mr. Weed the Department of Agriculture was requested to publish the proceedings the present year in a special bulletin. This motion prevailed.

Mr. Riley moved that in the event of the failure of the Department to take such action the matter of publication be left in the hands of a committee consisting of the officers of the society. This also was adopted.

On motion of Mr. Howard, it was ordered that the customary procedure be followed for the next annual meeting of the association, viz, calling it for the two days immediately preceding the meeting of the A. A. A. S. and at the place decided on for the meeting of the latter association.

The committee on nominations, consisting of Messrs. Lintner, Davis, and Rolfs, proposed—

For president, C. H. Fernald, of Amherst, Mass.
For first vice-president, F. M. Webster, of Wooster, Ohio.
For second vice-president, Herbert Osborn, of Ames, Iowa.
For secretary, C. L. Marlatt, of Washington, D. C.

On motion, the chair was instructed to cast the ballot of the association for the gentlemen named; and they were declared duly elected.

On motion of Mr. Southwick, the reading of the minutes of the entire meeting was dispensed with, and on motion of the same gentleman a vote of thanks was tendered the president and secretary of the association in recognition of their services.

On motion of Mr. Howard, the local committee in charge of the meeting at Springfield was given a vote of thanks.

President-elect Fernald took the chair and briefly expressed his thanks for the honor conferred upon him.

The association then adjourned subject to call.

C. L. MARLATT, *Secretary.*

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